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E.L. Tarbuck author, 1855-8, £85

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THE BUILDER'S

PRACTICAL DIRECTOR.

PUBLIC MEDICAL DISPENSARY.

FRONT ELEVATION.

THE BUILDER'S PRACTICAL DIRECTOR

THE

BUILDER'S

PRACTICAL DIRECTOR

OR

BUILDINGS FOR ALL CLASSES

CONTAINING

PLANS, SECTIONS AND ELEVATIONS

FOR THE ERECTION OF

COTTAGES, VILLAS, FARM BUILDINGS, DISPENSARIES, PUBLIC SCHOOLS &c.

WITH

DETAILED ESTIMATES, QUANTITIES PRICES &c.

ILLUSTRATED BY

NUMEROUS PLATES AND DIAGRAMS.

LEIPZIG AND DRESDEN A. H. PAYNE.
LONDON: J. HAGGER, 67 PATERNOSTER-ROW.

INTRODUCTION.

The purport of this work is to place before its readers in a plain, simple, and perfectly intelligible manner the whole art of Building, from the cottage of the labourer to the residence of the Esquire, to instruct those by whom it may be required in the art of admeasurement and all the necessary details of building and formation.

The great importance of the very numerous Building Societies now in existence, and the larger number still that we may reasonably infer will be formed, renders a more familiar and descriptive work upon Building necessary, and to fill up that void is the main purpose of this work.

The grand work of the improvement of the Working Classes and their comforts, so nobly taken up by the Nobility and Gentry of this country, and so ably carried forward, is worthy of all praise, and to forward these benevolent views this work will devote considerable attention.

And elementary introduction to Geometry so far as regards admeasurements of Superficies and Solids will be introduced as a necessary adjunct.

The site for Buildings will be described, pointing out the best method of drainage, and carrying off and rendering innocuous the deleterious gases generated therein.

The sinking of wells and the best methods of preserving the water from any impurities from drainage, will be treated as a matter of serious consideration.

The adaption of timber and the readiest way of rendering the same (be it taper or crooked) available without waste, will be clearly demonstrated.

The laying out of Lands to be divided into allotments, the best system of drainage and the formation of the pathways and roads will be fully explained, and plans, specifications, and estimates in detail, clearly to be understood by the Million, will be exhibited.

The plans, sections, and elevation of a labourer's cottage, consisting of four rooms with washhouse and fixtures every way complete, with detailed estimate, will be given, that may be erected for eighty pounds. This with 29 poles of Land would pay the Land-owner fairly at £ 4 ,, 5 ,, 0 per annum. And as the ministering hand of charity is never idle in this happy country, where even our Noble Ladies combine for the purpose of alleviating the pains of illness, giving comfort to the aged and education to the young, Plans for Public Schools and Medical Dispensaries will be introduced.

Farm Houses and Farm Buildings will form a most important feature, and the most improved method of retaining liquid Manures without injurious effect chemically explained.

The work will be so arranged that with its assistance any one may to a great extent become his own Surveyor and Builder; upwards of forty years continued experience in practical Building enabling the writer to place before the reader many tables and rules for ascertaining quantities and weights not generally known.

In a word, it is intended to lay before our readers a Handbook of Building, a reference to wich will be of use to the initiated as well as to those about to purchase plots of ground or to build houses.

INDEX OF DESCRIPTIONS TO PLATES.

INDEX OF GENERAL SUBJECTS TREATED.

ELEMENTARY INTRODUCTION.

Although it may be reasonably supposed that every reader of this work is fully acquainted with the arithmetical rules of admeasurement, lineal, superficial and solid, still there is no doubt they will be found not only useful but essential in this place.

The two-foot rule or 24 inch guage is what is always used by Joiners, Carpenters, and Bricklayers; it consists of 24 inches, each is divided into eighths and sixteenths.

LINEAL MEASURE.

Two sixteenths of an inch $^{2}/_{16}$	= one Eighth	$^{1}/_{8}$
Two eighths	= one Quarter	$^{1}/_{4}$
Four quarters, $^{8}/_{8}$ or $^{16}/_{16}$	= one Inch	1″
Twelve inches	= one Foot	1′ ft.
Three feet	= one Yard	1^{yd}
Five and one half yards	= one Rod or Pole	$1\ R^{d}$
Four poles, or 100 links, 66 feet	= one Chain	Ch.
Forty poles, or 10 chains	= one Furlong	Furl.
Eight furlongs or 1,760 yards	= one Mile.	Mile.
Eighty chains or 8,000 links	= one Mile.	

The chain consists of 100 links — each link being 7.92 inches, making sixty-six feet.

To reduce links to feet, multiply the number of links by 66, cut off two figures to the right, the remainder will be feet; and to reduce feet to links, add 00 to the number of feet and divide by 66:

Thus

```
 100 links
  66
 ----
 600
600
-----
66,00 feet
```

Again:

```
              66,00 feet
              -----
divide by 66 | 66,00 | 100 links.
               66
              -----
               ....
```

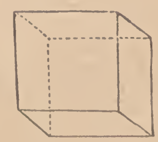
SQUARE OR SUPERFICIAL MEASURE.

144	Square inches	=	1 Square foot.
9	Square feet	=	1 Square yard.
100	Superficial feet	=	1 Square.
$30\frac{1}{4}$	Square yards	=	1 Square pole or rod.
40	Square poles	=	1 Rood.
4	Roods	=	1 Acre.
640	Acres	=	1 Square mile.

CUBIC OR SOLD MEASURE.

1728	Solid inches	1 Cubic foot
27	Solid feet	1 Cubic yard

Square.



Cube.

SIGNS AND MARKS NECESSARY TO BE REMEMBERED.

$+$ Signifies Plus or more: The sign of addition: as $8 + 6 = 14$ — meaning that 8 added to 6 is equal to fourteen:

Thus 6
add — 8
14

— Minus or less: The sign of substraction: as $30 - 6 = 24$. Meaning that six taken from 30, is equal to 24, or thirty less 6, equal to 24.

30
less — 6
24

$\times$ Multiply by: The sign of Multiplication: as $9 \times 6 = 54$. Meaning that 9 multiplied by six, is equal to 54.

9
Multiply by 6
54

$\div$ Divide by: The sign of division: as $20 \div 5 = 4$. Meaning that 20 divided by 5, is equal to 4.

Divided by 5 | 20
4

$=$ Equal to: The sign of equality: as 144 superficial inches = one square foot.

$::$ Proportion: The sign of proportion: as 4:8 :: 9:18 meaning that as 4 is to 8, so is 9 to 18.

$\frac{15}{27}$ Fraction, meaning fifteen parts of 27.

$\sqrt[2]{}$ Square root.

$\sqrt[3]{}$ Cube root.

CIRCUMFERENCE AND PERIMETER OF FIGURES.

It being a common matter of fact that to build a House, Cottage, or other erection, it is of the utmost importance to first obtain the land on which to erect it, therefore a knowledge of the shape or form of such land, which will be most beneficial, is of consequence, and very few are aware of the very great difference that exists in the areas of many figures that have the same perimeter, or measure the same distance.

The Circle contains more than any other figure known, and if we describe a square (see plate 1, fig. 1) which is 12 feet on each side, it will contain 144 superficial feet, and will be 48 ft. round. Now a Circle whose circumference shall be the same, viz. 48 ft., will contain much more (see plate 1, fig. 2).

Example. To find the diameter of a Circle, the circumference being given, multiply the circumference by 7, and divide by 22: Thus:

```
         48
          7
      -------
22 | 336 | 15 6/22
     22
    ----
    116
    110
    ----
    ..6
```

therefore $15^6/_{22}$ is the diameter of a Circle whose circumference is 48 ft.

Rule. To find the area of a Circle, the diameter being given, square the diameter and multiply by .7854, a decimal; the product, after cutting off 4 figures to the right, gives the area.

Example. Take in round numbers, without the fraction, 15 as the diameter of a Circle 48 in circumference:

```
                     15
                     15
                    ----
                     75
                    15
                    ----
                    225 = Square of diameter.
                  .7854 = Decimal.
                  ------
                    900
                  1125
                 1800
                1575
                --------
Area of Circle  176,7150 feet.
```

Take another form, that of a Parallelogram, whose longest sides shall be 14 feet, and its shortest 10 ft. (see plate 1, fig. 3); the perimeter of this figure will be found the same, viz. 48 feet — but the area will only contain 140 superficial feet, thus: 14 longest side, multiplied by shortest side 10

140 feet.

being 4 feet less in contents than a square.

Now proceed and lengthen the side to 16 feet, and the shortest to 8 (see plate 1, fig. 4); this has the same perimeter, but its contents are only 128 superficial feet.

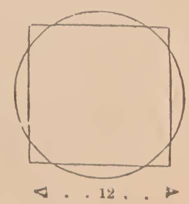
Again lengthen the longest side to 18 feet, and the shortest to 6 feet, (see plate 1, fig. 5); this is the same round, viz. 48 feet; but its contents are only 108 superficial feet, diminishing most materially.

One more example will suffice.

If we produce the parallelogram (plate 1, fig. 6) 20 ft. on its longest sides and four feet in the shortest, this will also be 48 in perimeter, for twice 20 are 40, and twice 4 are eight — but the area of this will only contain 80 superficial feet, being 8 ft. less than one half of the area of a Circle of the same circumference; this may still further be illustrated by taking the figure of a rhombus (see plate 1, fig. 7 to 12) containing 120 superficial feet; by bringing the two sides *A C* nearer and nearer to each other, the area will be reduced until the four sides merge into one straight line and the area is lost.

This is an important consideration, particularly as regards the walls of Buildings; for this clearly demonstrates that it requires the same amount of brickwork or inclosure wall for a Building erected in the form of fig. 6 containing only 80 superficial feet in area, as it does for one containing 144 feet.

Diagram shewing the difference in the areas or superficial contents of a Circle 48 feet in circumference, and of a square twelve feet on each side, making the perimeter the same as the Circle, viz. 48 feet.



The proportion of the areas of the different figures although they each measure 48 ft. around them stands thus — Plate 1.

Figure 1	area in superficial feet	144
2	ditto	176
3	ditto	140
4	ditto	128
5	ditto	104
6	ditto	80

PRACTICAL GEOMETRY.

Geometry is that science that teaches how to define and determine the shape and quantity of all superficial as well as solid bodies, and is a science of the most early antiquity. It is supposed to have been originated by the Egyptians, to define the boundaries of their lands after the periodical overflowing of the river Nile, which at those periods obliterated all traces of the previous demarcations. Thus this invention which originally was used only for the purpose of measuring out Lands to their proper owners from the various forms and schemes which it was then necessary to make for the allotments to be again marked out, led to the discovery of the valuable properties of the various figures, which continually improved and have advanced to the present time.

There cannot be a doubt but that the great Pyramid of Egypt is a Geometrical monument of more significance than is at present understood, but which may ultimately be explained by the intelligence and enlightenment of mankind, which progresses with such rapid strides and beneficial effect.

Geometry passed from Egypt into Greece, as we read of the estimation in which it was held there in the time of Plato, who flourished three centuries before the Christian Era.

Geometry enables us to ascertain truth, to argue truly and fairly, to understand the arts and sciences of Life, and to ascertain the shape and quantity and the admeasurement of all things measurable on, or in the Earth.

DEFINITIONS.

Definition describes shortly the several properties of Bodies and Things.

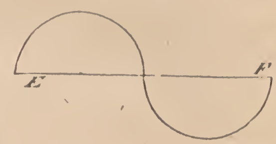
A Point or Atom is the first of magnitude, and we consider it not to have any parts, viz. neither Length, Breadth nor Thickness.

A line is produced by a point moving through space; it has length, but is not supposed to have breadth or thickness.

If a line be perfectly straight it is called a right line as *A B*.

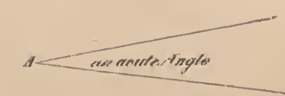
If a line be bent in any direction from a straight line in a circular direction, it is called a curve line as *C D*.

When a line bends or curves backwards and forwards in a circular direction it produces a serpentine line as *E F*.



When two right lines are projected to any length at equal distances from each other they are called parallel lines, see *A B, C D*.

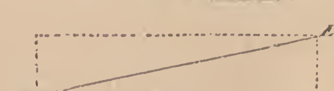
When two right lines incline towards each other at either end they will ultimately meet, and the point where they intersect is called an angle, as *A*, this angle is called acute, being less than 90 degrees.



When a right or straight line falls vertically and perpendicular on to another straight line which is horizontal, the angle made at their point of intersection is called a right angle, as *B*. This angle also forms a quadrant, or angle of 90 degrees.

If the lines fall from each other, the angle formed is greater than a right angle, being more than 90 degrees, and it is then called an obtuse angle, as *C*.

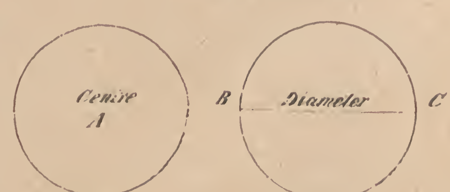
A line passing from one corner of a figure to another is called a diagonal line *D E*.

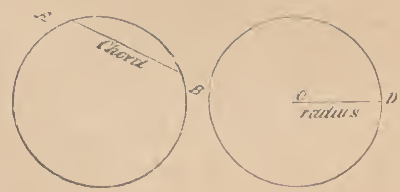


Diagonal line.

When a line curves round regularly and returns into itself, it is a periphery or circumference, the enclosed space is called the Circle, and the point in the middle, the centre, *A*.

If a line passes across a circle from one point of the circumference to another, intersecting the centre, it is called the diameter, as *B C*.



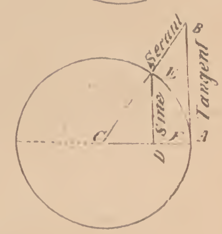


A right line drawn through any part of a Circle not intersecting the Centre, divides it into two unequal parts which are segments of a Circle; the line is the Chord *A B*, and the smaller part of the Circle the arch.

A right line passing from the centre of a circle to any part of the periphery, is called the radius, as *C D*.

A line that bends or coils round like a watch spring or coil of rope, is called an Helix or spiral line, *E*.

This figure is of great use in Building; by it the volutes of columns, curtail steps, and handrails of staircases are set out.



When a right line falls perpendicularly upon the end of the diameter of a Circle, so as just to touch the arch, it is called a tangent, as *A B*.

A right line drawn from the Centre of the circle to the end of the tangent *B C*, is called the secant of the arch, a right line falling perpendicular from any part of the arch upon the diameter within the secant, is called a sine, as *D E*, and that part of the diameter that is intersected between the sine and tangent is called the versed sine, *F*.

AXIOMS.

The following Geometrical Axioms, are propositions containing self evident truths which hold good, not only in numbers, but in lines, superfices and solids.

AXIOM 1.

The whole is greater than any of its parts.

AXIOM 2.

All the parts of any matter or thing taken together are equal to the whole.

AXIOM 3.

Things which are double to one and the same thing, are equal between themselves.

AXIOM 4.

If two equal things are equally increased or diminished, they still continue equal.

AXIOM 5.

If two equal things be increased or diminished unequally, they will continue unequal.

AXIOM 6.

From nothing nothing can arise; it has no value, properties, or form, nor any dimensions, either of length, breadth, or thickness.

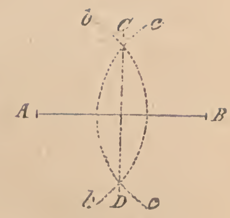
AXIOM 7.

Two right lines do not contain a space.

GEOMETRICAL PROBLEMS.

Problems are prepositions in practical Geometry, to demonstrate how certain operations or constructions that may be required, can be carried into effect by operations based upon universal truths.

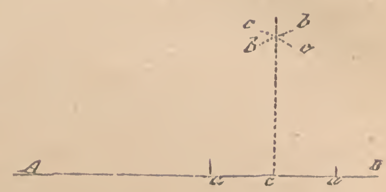
PROBLEM 1.



Divide a right line *A B*, into two equal parts.

Example. Open your compasses to more than one half of the given line, and setting one foot in *A*, describe the dotted line or arch *b b*, then place the foot of the compasses in *B*, and describe the arch *c c*, lastly through the points of intersection of the arches, draw the straight line *CD*, which will divide the line *A B*, into two equal parts.

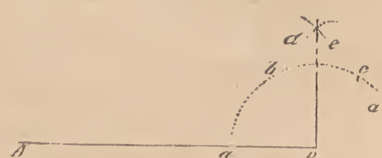
PROBLEM 2.



Erect a perpendicular upon a given point in a right line; let the point be *C*, in the right line *A B*.

Construction. Open your compasses to any convenient width, and placing one foot in *C*, make the marks *a a*, then open them to the width of *a a*, setting one foot on *a* to the right, describe the arch *b b*, now set the foot on *a* to the left, describe the arch *c c*; a line let fall from the intersection is the perpendicular required.

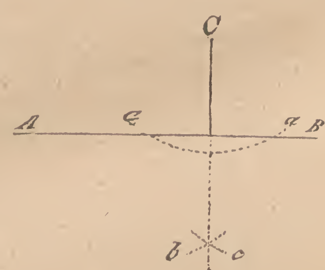
PROBLEM 3.



Erect a perpendicular on the end of a right line. Let *A B* be the right line, and *B* the end on which the perpendicular is to be erected.

Construction. Open your compasses some convenient short distance, place the foot in *B*, and describe the dotted arch *a a*, with the same opening of the compasses place one foot on *a* and make the mark *b*, with the same opening fom *b* make the mark *c*, then from *b* and *c* describe the arches *d* and *e*, from their intersection drop the line to *B*, which is the perpendicular required.

PROBLEM 4.



Let fall a perpendicular upon a right line given from a point any distance above it.

Let *A B* be the right line, and *C* the point from which the perpendicular is to fall.

Construction. Open your compasses to a distance more than the length of the perpendicular required, set one foot on *C*, and describe the dotted line *a a*, from its intersection with the line *A B* describe the arches *b* and *c*, from their intersection draw the line from *C*, which is the perpendicular required.

PROBLEM 5.

To draw a line which shall be at an equal distance and parallel to another line at any distance. Let the right line given be *A B*, and the distance of the parallel be equal to the line *C*.

To project this line open your compasses to the length of the line *C*, place one foot near the end of the line at *A*, and describe the arch *a a*, do the same near *B*, and describe the arch *b b*; a line drawn on the crown of the arches will be parallel to the line *A B*.

PROBLEM 6.

To lay down or form an angle of any number of degrees.

Construction. Draw a Circle and divide the circumference into 360 parts; from the diameter thereof, prick off the number of degrees required, and draw a line from thence to the Centre; it will form the angle required.

NB. As no instruments are without the protractor, from which angles are most readily laid down, no diagram of it is here necessary.

PROBLEM 7.

Divide an angle into two equal parts.

A B C is the given angle to be divided into two equal parts.

Construction. Open your compasses to any convenient length within the angle, place one foot in *A*, and describe the arch *a b*, with the same opening place one foot in *a*, and describe the arch *c*, do the same in *b*, and describe the arch *d*; a line drawn through their intersection through the point *A*, divides the angle as required.

PROBLEM 8.

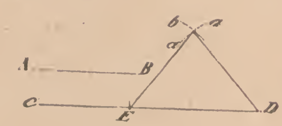
To lay down an angle equal to an angle given: let *A B C* be the given angle.

Construction. Open your compasses to a width about one half of the leg of the angle, place one foot in *A*, and describe the arch *a b*, draw the line *D E*, and with the same opening of the compasses and the foot on the point *D*, describe the arch *c d*, take the line *a b* in the compasses, and placing one foot in *c*, set off the same on the arch *c d*; a line drawn through that point to the point *D* is the angle required.

PROBLEM 9.

Construct a triangle which shall be on each of its sides equal to the line *A B*.

Construction. Draw the line *C D* something longer than the line *A B*, open your compasses to the line *A B*, place one foot in *D*, and describe the arch *a a*, at the same time make the mark *E*, with the same opening place one foot in *E*, and describe the arch *b b*; lines drawn from the intersection to *D* and *E*, will form the triangle required.



PROBLEM 10.

Divide a given right line into any number of equal parts.

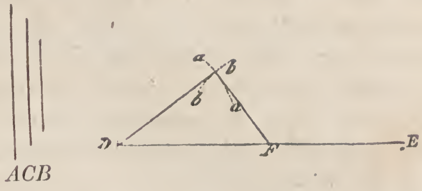
Suppose *A B* to be the given line which it is proposed to divide into six equal parts.

Construction. From the point *B*, project the line *B C*, at any acute angle, from *A* project the line *A D*, parallel to *B C*, (see problem 5 or problem 8), open your compasses to any small distance and with one foot in *B*, set off 5 divisions in the line *B C*; with the same opening place one foot in *A*, and set off 5 divisions on the line *D*; draw lines from one to five, two to four, through the whole number of figures; they will equally divide the line required.

PROBLEM 11.

Lay down a Triangle whose sides shall be equal to three lines given — two of the lines to be longer than the third.

Take A, B, C, to be the given lines.

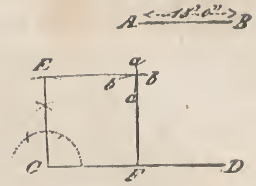


Construction. Draw the line D, E, longer than the line A,—open your compasses to the length of the line A, set one foot in D, and make the mark F,—then take the line B, in the compasses, set one foot in D, describe the arch a, a, with the compasses adjusted to the line C, set one foot in F, and describe the arch b, b: lines drawn from their intersection to D, and F, give the required triangle.

PROBLEM 12.

It is proposed to form a perfect square, each of the sides to be equal to the given line A, B.

Let the line A, B, be given, and its length to be 15 ft.



Construction. Draw the line C, D, longer than A, B, erect a perpendicular (see problem 3) upon the point C, and set off the line A, B, upon it to E, and F, with the compasses; at the same opening place one foot in E, and describe the arch a, a; with one foot in F, describe the arch b, b: lines drawn from their intersection to E, and F, will form the square required.

This problem having been solved, and the figure being superficial, let it be measured.

Rule. Multiply the length of one of its sides by another; the product is the superficial contents.

Example.	Side or line, A, B,	15′ „ 0″
	Multiply by same	15
		75 „ 0
		15.
	Superficial contents in feet:	225 „ 0

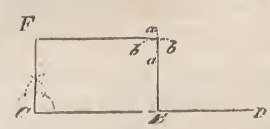
PROBLEM 13.

It is required to form a long square called a parallelogram from two given lines, so that its length and breadth be equal to the two right lines given.

Let the given right lines be A, ______17 ft. long.______

and B, ______9′ „ 0″______

Its superficial contents also to be given.



Construction. Draw the line C, D, longer than A, take the line A, in the compasses, and set it off from C, to D, and E, erect a perpendicular upon the point C, (see Problem 3) upon which set off the line B, at F, upon your compasses to the length of the line A, place one foot in F, and describe the arch a, a, close the compasses to the exact length of the line B, set one foot in E, and describe the arch b, b: lines drawn from their intersection to E, and F, will form the parallelogram required.

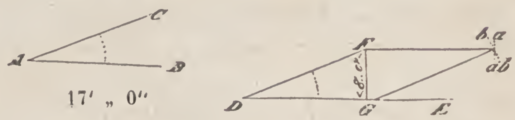
Rule to find the superficial contents of a parallelogram or long square: multiply the sum of the longest side by that of the shortest, and the product gives the contents.

Example.	Sum of longest side	17′ „ 0″
	Sum of shortest side	9 „ 0
	Product in feet	153 „ 0

PROBLEM 14.

To describe a Rhombus, whose sides are to be equal to a given right line; and its angle equal to the acute angle given.

The lines *A*, *B*, and *A*, *C*, each 17 feet long, form the sides of the Rhombus required, and the acute angle *A*, *B*, *C*.



Construction. Project the line *D*, *E*, longer than *A*, *B*, make the angle *D*, equal to the angle *A*, (see Problem 8). Open the compasses to the line *A*, *B*, set one foot in *D*, and set off the distance on both legs as *F*, *G*; with the same opening, place one foot in *F*, describe the arch *a*, *a*; with the same opening place one foot in *G*, and describe the arch *b*, *b*. Lines drawn from their intersection respectively to *F*, and *G*, will describe the Rhombus required.

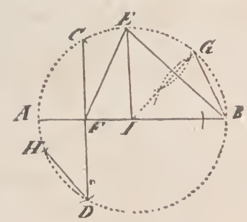
Rule to find the area of a Rhombus. Multiply the sum of one side by the perpendicular height; the product is the area.

Example.	Sum or length of side	17′ „ 0″
	Perpendicular height	8 „ 0
	Area in feet	136 „ 0

Note. A square with the same length of side, viz. 17′ „ 0″, would inclose an area of 289′ „ 0″ superficial feet.

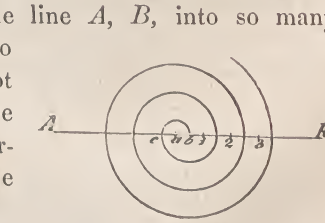
PROBLEM 15.

Divide the circumference of a circle into any number of equal parts up to ten. Draw the diameter dividing it into two parts *A*, *B*, open your compasses to the width of the semi-diameter or radius, set one foot in *A*, and mark the circumference in *C*, *D*; that line will divide it into three equal parts; erect the perpendicular *E*—a line drawn from *E*, to *B*, divides it into four equal parts; draw the line *E*, *F*, which divides it into five equal parts; the semi-diameter or radius divides it into six; one half the third part *F*, *D*, will divide it into seven equal parts; divide the line *B*, *E*, and where the line drawn from the centre cuts the circumference at *G*, draw the line *G*, *B*, that line will divide it into eight equal parts; take one third of the arch *A*, *C*, *D*, and draw the line *H*, *D*, that space will divide it into nine equal parts; lastly the line *F*, *I*, divides it into ten equal parts.



PROBLEM 16.

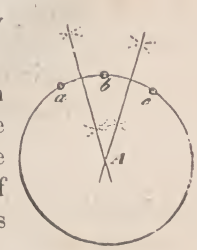
Describe a spiral line upon a given line. Divide one half the line *A*, *B*, into so many parts as there are to be revolutions, as 1, 2, 3; divide *a*, 1, into two equal parts at *b*, with that opening of the compasses and the foot in *a*, describe the arch *b*, *c*, place them with the foot in *b*, open the other to *c*, and continue that line, and continue the lines by alternating the centres *a*, *b*, and extending the compasses to meet the spiral line.



PROBLEM 17.

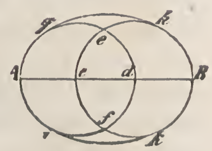
Find the centre of a circle which shall pass through three points given; they not being in a straight line, let *a*, *b*, *c*, be the points given.

Construction. Open the compasses to *a*, *b*, and describe the arches shewn in the dotted line by alternating from *b*, to *a*; do the same with the distance from *b*, to *c*, then draw straight lines through their intersections; and where these lines meet or cut each other, as at *A*, that point is the centre of a circle, the circumference of which will pass through the three points given.



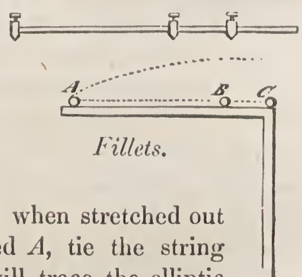
PROBLEM 18.

Describe a geometrical oval upon any given line, say *A, B*, whose transverse diameter is 21 ft., and the conjugate diameter 13 ft.



Construction. Divide the given line into three equal parts; open the compasses to any one of these parts; with one foot in *c*, describe a circle; with the same opening and foot in *d*, describe another, cutting each other at the points *e, f*; take the diameter of one of the circles in the compasses, place one foot in *f*, and complete the upper curve *g, h;* with the same opening and the point of the compasses in the intersection *e*, describe the curve *i, k*, which completes the oval desired. This is a most useful problem in all works of formation, and is to be found,—that is, one half thereof, or its section,—ornamenting with its beautiful curve the entrance passage of the smallest dwelling, as well as exciting our wonder, when, spanning the impetuous tide, it presents its noble proportion as the sustaining arches of the bridge. It very often happens that the geometrical oval, or ellipsis, will rise too high, and it will be required to obtain a curve much flatter or lower on the crown. Curves of this shape may be obtained by means of a trammel,—which is an instrument well known, possessing one fixed and two moving points,—by adjusting the two outer points to one half of the longest or transverse diameter, and the third between them to the conjugate or shortest diameter, and fixing two laths or fillets perfectly square; by passing the two moveable points along the right angle the curve will be formed by the fixed or end point. Suppose the distance, *A, C*, to be one half of the opening or curve to be marked out, and *B, C*, the height; if you pass the point of the trammel *c*, down the vertical fillet, the point *A*, will follow and gradually rise and form the dotted curve line; when *B*, arrives at *C*, one half the curve is struck; reverse your fillets, and the same operation will complete the curve. Joiners and carpenters have a ready way of striking flat elliptic curves with a chalk line thus; within a very short distance of the extent of the opening desired insert two bradawls, put a string encompassing them but loose enough when stretched out in the middle to extend to the height of the curve or arch required *A*, tie the string and pass a pencil or point along the string, keeping it stretched; it will trace the elliptic curve desired.

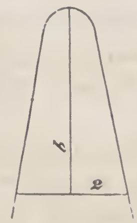
Trammel.

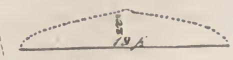


Fillets.

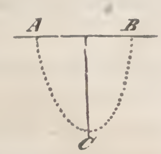
To find the area of an oval. Multiply the length of the transverse or longest diameter by the length of the conjugate or shortest diameter, and that sum by 7.854.

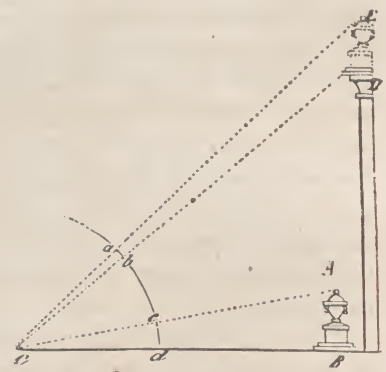
Example.	Transverse diameter	21
	Conjugate diameter	13
		63
		21
		273
		7.854
		1092
		1365
		2184
		1911
	Area in feet	214,4142





While treating upon these figures and curves, mention may be here made of the parabola, one of the conic sections which is useful when it is required to find a curve for the Tudor arch; thus if a Tudor curve be required 12 ft. wide to rise 2 feet, one leg of the parabola will give one half the curve. A more ready way to form the Tudor curve is by the catenary or chain; project a level line upon any face wall, from the centre of which drop a perpendicular, drive two nails into the wall each at a distance from the centre or perpendicular equal to the height of the arch as *A*, *B*, upon the perpendicular make a mark *C*, to be one half of the proposed opening of the arch, place one end of a strong Jack-chain upon one nail, and drop the chain over the other until it touches the mark *C;* this will, as before, give the curve required.





Whenever it be found necessary to place any pedestal, or ornament, at a certain height upon a building, which it is desirable should appear to the eye of the same height or size as if it stood upon the natural ground, the following will give the height required:—

Example. Let *A*, *B*, be a pedestal and vase, and *C*, be the point or distance for it to be seen from, and that it is wished it should appear of the same size as *A*, *B*, when placed upon the wall or column at *D*, forty feet above it, the point *C*, being sixty feet from the pedestal.

Construction. Draw the line *C, B*, then open your compasses to any convenient distance, place one point in *C*, and describe the arch *a*, *b*, *c*, *d*, then draw the dotted lines *C, A*—*C, D*. Now as all objects appear viewed under a certain angle, in proportion to their distance from the point of sight, and whenever those angles appear equal, the objects, however placed, must appear so too, take that part of the arch *c*, *d*, in the compasses and set the distance off from *b*, to *a*, through that point draw the dotted line *C*, *E*, and where that line cuts the perpendicular, that intersection will be the required height of the pedestal and vase, viz. from *E*, to *D*. Figures, cornices, letters, or inscriptions, to appear of a certain size at a certain height, are ascertained by this method.

FOUNDATION AND BUILDING SITE.

SITUATION AND ASPECT.

In the erection of small cottages, or houses, there very rarely happens any chance for choice of situation; but where a residence has to be erected encompassed by grounds, due care should be taken to secure the most congenial aspect both as regards prospect, light, and warmth. All these depend upon locality, and the aspect of the building in one situation may be both light and genial, while in another spot the very reverse may be the case. A southern aspect is generally approved and adopted; or the south and south-east, this still being guided by prospect or protection: the north and north-east winds are in this country piercing cold, and not at all conducive to health; and wherever shelter by high land, or forest trees, can be obtained, the building should

be erected under such protection; a rising spot of ground is to be preferred, but should that not be attainable, the excavation, from the basements of foundation, will form an easy and desirable slope from the level to the ground-floor entrance. In excavating, care should be taken to preserve the upper mould or surface; the whole space should be carefully unsoiled to the full depth of the mould and vegetable earth, and wheeled to some convenient distance, so that it may not be injured by workmen and moving of the materials employed in the erection; all sand or good grit that may be found should also be kept separate and used for mortar, and the gravel, if any, at once twice screened, the coarse to be used for metalling the roads, the hoggen or fine preserved to surface the foot-paths, and the fine grit used with the mortar, should the substratum be clay; unless it be worth while to burn it for roads, or if in quantity manufacture it into bricks or tiles, it would no doubt be advisable otherwise to get rid of it in the best manner possible, which is this. — Ascertain the quantity of cubic yards of the clay or substance not available, and then find how far it will extend around the building, to form an easy slope up to the entrance or rising towards the ground-floor, remembering that one cubic yard will give a slope nine feet long with a rise of two feet from nothing and three feet wide. This calculation readily gives the distance the clay will extend, to form the slopes; when ascertained, take off the mould from all that surface, remove it as before, and throw out the clay, and roughly form the slope upon the unsoiled space, which leave to receive the rubbish that may accumulate during the erection; and when the whole is finished the rich top dressing of the mould may be readily restored, and the slopes dressed with it to an equal depth all over. The basements or trenches excavated for the foundations of the walls should be properly and carefully levelled and dressed fair, and the level should be carried out from the lowest spot, so that when finished quite level, the whole space or bottoms shall be undisturbed ground; all parts thereof where the walls are to stand should be then sounded by being heavily struck with the pointed end of a stout crow-bar, and if any defective places be found they must be excavated down to the solid firm substratum, the parts thus excavated below the general level to be filled up to the proper height with concrete, or brickwork as may be approved. Should the excavation for the basements or trenches for the foundations of the walls prove to be sand—however useful it may be when mixed with lime to build with—it is very unsafe to build upon, and much difficulty is very often found to secure a foundation thereon, this requiring in all cases very great care; although sand when confined is as firm and secure as gravel, still any excavation near any water-drift that may by possibility occur, at once renders it insecure. The best way in a difficulty of this kind occurring is to produce the widest base or footing that can be most readily laid, because in any attempt to lay bricks on a footing of sand, it will often happen, particularly in drift sand, that one brick will be out of sight before another can be laid; but when embedded it is difficult to withdraw them. In the sand-drifts of the London sewers, which frequently occur, the usual practice to get in the centre courses of the circular bottom of the sewer, is to cement together in a wood-mould three or four courses of bricks in width by four course or three feet in length (see Plate 9, fig. 1), and carefully drop them into the intended position: but very great care must be taken in their proper adjustment and the cementation of the heading joints, where each length interlocks with the other; if not, a sinking of only one from or below its proper level will cause a water-drift into the sand from the passage of the sewer water, and cause a failure of the whole structure, if not attended to in time, of a considerable length. To drive piles into sand is folly, because they are useless when there; and the difficulty of drawing them out is as much or more than their worth. Should a solid bottom be found at a certain depth under the sand, then piles are of use; but a careful calculation of the weight to be supported must be made, that a sufficiency of piles be driven to bear the weight to be placed upon them; in such cases the piles should be green beech, round and taper as they grew, thus forming a conical pillar inverted, which increases its lateral pressure as it is driven down, and does not, like a square pile, depend upon its point and lateral

pressure of one bulk only: driven throughout, elm, red pine, good pitch-pine or Memel sleepers, half timbers, should be tenoned or dowelled with charred dowels, down upon the heads of the piles, and the spaces between them filled in flush with concrete, cross or transverse timbers of a smaller scantling, say 10 >< 5, spiked well down to them, and the space between filled with concrete, or brickwork, as before. Quarry-faced York slab, varying in thickness in accordance with the weight of the building, should be bedded in good mortar thereon; upon which the wall may begin to rise. Should no such substratum be found, get out the base for the walls of a sufficient width to admit quarry-faced York slabs much wider than the brick footings; or for a guide, say for a house of three stories, let the quarry-faced slab be three inches thick and in width or length, that is to say transversely under the wall, of such dimensions as to extend on each side at least one foot beyond the width of the first course of brick footings; and for an additional story in height, add 1 inch to the thickness of the quarry-faced slab, and three inches on each side for the extension of the footings. Great care must also be taken in laying them down, so that they meet the surface of the sand upon every part of their surface simultaneously. It is well known how much greater weight any yielding material will bear in proportion to the extent of surface place upon it. A schoolboy, who in throwing his ball finds it unfortunately arrested in its progress by the thick mud on the bank of a pond or river, cautiously with one foot tries how far he can trust himself upon the treacherous deposit; but the small surface of his foot is buried instanter, and if he unfortunately happens to lean slightly too forward, his leg is immersed in the yielding mass up to his knee, and great difficulty is found in withdrawing it. This little instinctive *Philosopher* will seek a tile, a piece of wood, a good tuft of straw or grass, or any matter possessing surface, and, placing it on the yielding deposit, and his foot upon that, he is supported without danger. Any person walking upon ice, and finding it to have a tendency to crack or yield, by lying down upon it, is perfectly safe. A man weighing twelve stone, or one hundred and sixty eight pounds, when standing upright is supported on a surface of about 77 superficial inches; but lying down, the supporting surface is immensely increased, and will be found to be something near 1200 superficial inches, or upwards of fifteen times the area of an upright position; the only inconvenience to be experienced is, that instead of walking to the shore, the experimenter would have to roll the distance. From the philosophy of such little matters immense results arise, and very accurate data are demonstrated, as to the bearing surface of various substances forming a substratum for works about to be erected; and from the various practical experiments that have been made and calculated by scientific men, the following rules may be safely taken with respect to the bearing of piles, when a pile be driven to a state approaching inertion, that is, when the ram merely drives the pile regularly about one quarter or half an inch.

Note. The number of times that the distance driven is contained in the distance of the fall of the ram, divided by eight, is the number of times the weight of the ram that the pile will bear.

Example. A ram of six hundred-weight falling twenty feet drives a pile one half inch.

Twenty feet = 480 half inches

480 -:- 8 = 60 >< 6 = 360 Cwt. = 18 Tons.

A ram of eight hundred-weight falling twelve feet drives a pile one half inch.

Now twelve feet the fall contains two hundred and eighty-eight half inches which, divided by eight, gives thirty-six hundred weight, equal to fourteen tons and eight hundred-weight, being the weight the pile is equal to bear: thus 12 feet = 288 half inches

288 -:- 8 = 36 >< 8 = 288 Cwt. = 14 Tons. „ 8 Cwt.

One of the most essential things to be considered before a building be erected, is first the supply of water for the use of the domestic appliances, whether by supply from water-works,

from rivulet, or from wells; another material matter to be fully understood is, in what way and best manner the drainage is to be carried off. If a well has to be sunk, let a convenient spot be selected, as near as can be to the point where the pump is intended to be placed; and in sinking the well, if it be a very dry season, care should be taken to ascertain the height the surface springs will rise to when at their lowest, by sinking the well four feet below such level: so that when four feet of water will be in the well at the lowest springs, it will be found to afford a sufficient supply. Should the ground be very sandy, a wooden curb made of two rings of elm in two thicknesses, 4 inches wide, and boarded on the sides with boards close jointed, forming a cylinder about four feet high and of the size of the diameter of the well, is to be sunk and then filled in with bricks; and as the same lowers by the excavation below, the brick steining should be continued upon the top of the curb until the same rises within three feet of the ground: from that point spring a dome, and carry that over until it closes in the mouth of the well, leaving an aperture about eighteen or twenty inches in diameter, which cover over with a piece of York stone. At the farthest point possible from the pump-well, begin your drainage; and should a cesspool be necessary, let it be sunk at the greatest possible distance from the pump-well that you can obtain, to secure a fall for the drainage water. The drains should be of glazed stone water-pipes, very carefully clayed together at the joints of intersection, so that no escape of the impure water passing through them be possible; the size of the pipes to be such as to carry away the waste readily: for common purposes a four-inch pipe is amply sufficient. Wherever the premises are situated in a piece of garden, or have a moderate piece of ground attached sufficient to use the sewage, the cesspool should be square, or, if round, part of the top thereof should open, and all the waste cinders, ashes, and other refuse, thrown therein; it acts as a deodoriser, and will form sufficient manure for the garden, being partially emptied whenever any ground be turned up. In other cases, when it be closed in, let there be a small outlet pipe proceeding from the side of the cesspool at a level with the drain-pipes, and lead away to some distant part open to the atmosphere. Should no such low ground be approachable, let the pipe rise to the surface in some secluded or out-of-the-way spot (see *A*, plate 11, fig. 1) remembering that the open or top part of the outlet pipe be some few inches in level lower than the syphon or trap of the upper part of the drain pipe next to the dwelling: and in cases where it is practicable, it is wise to have an outlet pipe from the drain pipe outside the house, (see *B*, fig. I. plate 11), such outlet pipe, that is, the orifice thereof, to be below the level of the water in the syphon trap of the pan (see *C*, fig. I, plate 11). It is the usual practice to keep our outside water-closets low, indeed even with the floor level, or only the thickness of the sill of the door case above the surface; the floor should rise at least one step; the higher the seat, the better the fall, and, as a matter of course, more advantageous for the drainage. In the case of water-closets in upper floors, they are most readily kept free from noxious vapour by having a gas outlet pipe passing from the soil pipe through the wall of the house, some distance below the trap valve, or syphon of the pan, (see *A*, fig. 2, plate 11).

The philosophy of the gas-escape pipes will now be explained. The noxious exhalation that proceeds from the sewage matter of drains and sewers, is principally and generally the gas called sulphuretted hydrogen, and is a compound heavier than atmospheric air, and therefore it falls like water over the brim of any overfilled vessel; whenever it can rise above the space in which it is generated or confined, during the decomposition of the various animal and vegetable matters carried into the cesspools, the gas is generated more or less in immense quantity; and if there be not any outlet for its escape, it becomes compressed, and, in warm or sultry weather, is generated so rapidly as to become compressed into considerably less than its ordinary volume, and consequently highly elastic; in such case the whole of the upper part of the cesspool, the sewers or pipe drain, and every part thereof, is filled to pressure with the noxious effluvia, even to pressing with some considerable force under the valve or trap, or against the water in the syphon

Therefore, the instant the valve of a closet be opened, the gas rushes out in its compressed state and expands into a volume of fœtid vapour of some cubic feet. In fig. 2, plate 11, the gas, however rapidly it may be generated, cannot rise higher in the soil pipe than *B*, because it is running out at *A*, and is rapidly taken up by the atmosphere without inconvenience, and the space from *B*, to the syphon is free; at all events that space is without pressure, there not being any tendency for the gas to rise above that point.

It may not be considered out of place to insert here a very ready method of decomposing this gas, and in the case of cleansing cesspools or drains where it may exist in quantity sufficient to be offensive, place about one ounce of powdered nitre into a shallow saucer, and pour about an ounce, or a little more, of sulphuric acid upon the nitre; stir with a piece of stick: the sulphuretted hydrogen is decomposed, and nitric acid is set free. Thus:—

Nitre is { Nitrate of Potash } and consists of
Nitric acid ——— set free
and
Potash,
Sulphuric acid

combines with the potash, and forms sulphate of potash, and sets the nitric acid free. Cleanliness in all cases is conducive to health, and wherever the syphon pan closets are used,—and their cheapness and convenience must bring them into general use—all water that may be useless should be emptied down them, in small cottages or houses not supplied with a cistern. Should a pump be near, a ready supply of water may be obtained from it (see plate 11, fig. 3). Place a small wood cistern *A* in any convenient place between the pump and the closet, let the top of the cistern be level with the top of the cistern head of the barrel of the pump, let a $^3/_4$ inch lead pipe *B* be inserted into the lead cistern, immediately under the level of the orifice of the pump nozzle, and run at a level from there into the cistern *A*; from the bottom of the cistern *A* continue another $^3/_4$ pipe, with a common cock inserted at any convenient part thereof at *D*, and insert the other end of the pipe into the neck of the pan at *C*; it is evident that the cistern *A* will always be supplied when the pump is used, the small pipe being inserted below the orifice of the nozzle, the cistern must be filled before any water can pass through the nozzle. However plentiful the supply of water may be, it should not be used unnecessarily, and when the supply proceeds from a butt, tank, or cistern, they should be properly cleaned out at short periods; and if supplied from a well, let not any hole, drain or even surface-water lay, or be permitted to remain in its vicinity. All water percolates through the strata of the earth; and the stagnant water of a cesspool, in a few years, has been known to destroy a well of fine spring water at a distance of upwards of 40 ft.

PLAN, ELEVATION, AND SECTIONS OF A LABOURER'S COTTAGE

(See Plate 32.)

Consisting of five rooms. To have hollow brick or rubble walls, with slated roof and brick-nog partitions—the whole fitted with stoves, copper, and stone sink; and containing—

A Living room, 12 ft. by 11 ft. and 8 ft. high.		1056	Cube ft.
A Family bedroom, 11 ft. by 10 ft.	ditto.	880	ditto.
A Female's bedroom, 10 ft. by 9 ft.	ditto.	720	ditto.
A Boy's bedroom, 9 ft. by 6 ft.	ditto.	432	ditto.
A Washhouse, 9 ft. by 6 ft.	ditto.	432	ditto.

The oven to be erected in the centre of the four corner chimney-breasts, the shutters to be flush ledged and hung with hooks and eyes, (not butts), and to have iron legs to drop and form an ironing board when required, the two legs to fall into two hooks screwed to the casement frames and thus become the fastenings when the shutters are closed.

This comfortable, convenient, and snug little residence, with the addition of about 30 poles of land, may be built to pay six per cent upon the outlay, including rent of the land, by letting it at a rent of only two shillings per week.

SPECIFICATION

OF WORKS TO BE DONE IN THE EXCAVATION OF FOUNDATIONS, AREA. AND DRAINS, AND IN THE ERECTION OF ONE LABOURER'S COTTAGE CONTAINING FIVE ROOMS ON THE GROUND-FLOOR.

(See Plate 32.)

Excavator. Excavate the whole of the ground to be covered by the building to the depth of 9 inches at the least, and ram the same where the walls are to stand; dig trenches for drain-pipes as directed, and form and sink, in such situation as may be pointed out, a cess-pool not less than six feet deep.

Bricklayer. Provide and lay with clay joints forty feet of 4-inch drain-pipes, including syphon; carry up the walls hollow 9″ in. thick, and the brick partitions with proper footings as shown in plan; provide and work in six iron air bricks where directed; the brickwork to be carried up with kiln burnt, hard clay, or other hard, smooth-faced bricks, laid in grey stone lime, and sharp sand mortar; the outside of the brickwork to have a neat plain joint, and the inside of walls and both sides of partitions to be worked fair, flush, and face pointed, and rubbed to receive colour; stein the cesspool, work in all the doors and sash frames, and make good to them; bed all sills and frames, core the flues, and fix compo or other chimney-pots thereon; erect oven in middle of flues (as shown in plan), set the galvanized iron pot and stoves, fix sink, pave the living-room and washhouse with sound hard bricks laid on lime core, black ash, and sand concrete herring bone courses; project brick neatly cut corbels to receive stone mantelshelves, and finish brick opening for chimneys with flat arris very neatly; and do all brickwork required to finish the building, as per drawing.

Carpenter. Prepare solid door and bevelled mullion window frames for sashes, or casement lights, as may be directed, ready to be worked into the brickwork and properly secured; the door frames to have York quarry faced sills mortised for posts, and the inner frames to form part and parcel of the $4^1/_2$ inch brick nog partitions, the entireties of which are to be mortised and pinned into the door frame about middle rail high, and the head to be run all through from chimney to walls; put wood bricks where required, lay ground floor joists with sleepers upon dry bricks, all $4^1/_2'' \times 2^1/_2''$, the partition the same, framed to doorways, but no bottom plate, except the stone sills of doors, the ceiling joists to run through $4'' \times 1^1/_2''$, plates $4'' \times 2^1/_2''$, rafters $4'' \times 1^3/_4''$, the purlins $4'' \times 4''$, to be strutted to the heads of partitions and properly secured thereto, and the ceiling joists; the hips to be $9'' \times 1^1/_2''$; lay $^3/_4$ inch eaves boards, and $^3/_4''$ slating battens; erect privy over cesspool of light quarters, and feather edge boards, inch-elm seat and riser and floor, with $^3/_4''$ ledge door hung and fastening; lay the floors of bed-rooms with 1″ cut spruce battens prepared and laid folding; prepare and hang inch ledge doors to all the doorways; provide and put on proper fastenings; fit flush ledge shutters to the windows hung to sill to form dressers or tables if required; fix all stops and linings, and complete all carpenters' and joiners' work required; the timber to be sound Baltic, or other approved resinous wood.

Slater. Slate the whole of the roof with Countess slates properly nailed with zinc nails, and put slate fillet ridges, laid in putty; the under side of fillets to be painted on all the hips.

Plasterer. Lath, lay, and set all the ceilings, white stop and color all the walls and partitions, and run 4 in. cement skirting round four rooms.

Plumber. Put lead fillets to bottom of all window sills 4 inches wide, to project 2 inches from wall, put 4 inch half-round iron gutters to eaves and cistern heads, and pipes to convey water to butt, glaze all the sashes or casements; stain all the woodwork with oak stain, or other approved dye, and do all plumber's und glazier's work required.

Smith. Provide and fix one galvanized iron 15 inch pot and ironwork, one 24 inch or small cottage range, two small elliptic stoves, three stock locks, eight rod bolts, twelve pairs 14 inch X garnets and screws, four iron legs for shutters, seven Norfolk latches, four chimney bars, etc.

Mason. Provide and fix one 18 inch stone sink, three York rubbed mantels for chimneys, to be fixed on corbels, and 12 feet 2 inch quarry-faced York for front and back doors.

ESTIMATE.

BILL OF QUANTITIES. SEE PLATE 32.

COST OF ERECTION OF ONE FIVE ROOMED LABOURER'S COTTAGE.

Yards.	Feet.			L	s	d
15	0	Cube yards excavation	4d	—	5	0
3	27	Rods reduced brickwork, part hollow	—	32	10	6
	40	Lineal 3 inch drain pipes, one trap	3d	—	10	0
	50	Superficial yards lath lay set	1s 3d	3	2	6
	—	One cesspool and digging	—	—	17	0
139	—	Superficial yards color to walls	2d	1	3	2
11	0	Superficial brick paving flat	1s 6d	—	16	6
		One stone sink and pipe	—	—	6	0
	150	Lineal feet four inch cement skirting	1d	—	12	6
	8	Number squares of Countess slating	22s	8	16	0
	50	Lineal feet slate fillets in putty	2d	—	8	4
	8	Number of squares of slating battens	5s 6d	2	4	0
	5	Number of stone sills	9d	—	11	3
	2	Number of jaumbs and heads door cases fir wrought . .	—	—	12	0
	82	Cube feet fir framed	2s 6d	10	5	0
	96	Lineal feet 3 in half round zinc gutter fixed	4d	1	12	0
	96	Lineal feet 6 in eaves board	2d	—	16	0
	2	Number of squares flooring	25s	2	10	0
	90	Superficial feet ledge doors hung	8d	3	—	0
	80	Superficial solid casement frames glazed	1s	4	0	0
	50	Superficial $^3/_4$ ledged shutters hung	8d	1	13	4
	108	Superficial feet feather-edge and quarter erection of privy floor, seat and riser		2	10	0
		2 stock locks $^4/$, 7 bolts $^3/_6$, 5 pairs 14 in. X Garnetts screws		—	14	6
		Enamelled iron pot, 15 inch, 3 stoves and fixing, Elm slab for oven mouth		2	0	0
		Contingencies, paving etc.		1	10	0
			£	83	5	7

CONCRETE.

In all works for foundations and footings wherever the ground is unsound, the use of concrete for a substratum is of the most essential service, particularly in all soft and treacherous or yielding soils; and there is no doubt but that it will eventually supersede every other method, it being an available, economical, and substantial resource in many difficult situations. Concrete is a compound of stones or rubble and sand, with fresh burned stone lime ground to powder without slaking, in the proportion, as generally used about London, of five parts of gravel and sand, to one of stone lime measured dry. These component parts, say five bushels of gravel and sand and one of lime, should be well turned or shovelled together with a quantity of water added, only sufficient to slack the lime into the state of very stiff mortar after turning the compound over with the shovel once or twice. As it sets quickly, the mixture ought to be made close at hand, and as near to the spot from where it is to fall as possible; and being immediately spread and levelled, it should not again be touched, care being taken in all cases that the trench be filled close up to the sides in every part. Concrete may be formed of clumps of stone mixed with sharp sand, particularly of Kentish rag, broken as for the making of roads, and the small chips left therein, coupled as before with good coarse sharp sand. This mixture condenses in formation, but expands considerably in setting, in most cases as much both vertically and laterally as $^1/_4$ of an inch to the foot, which insensibly increases for some continuous time after it has hardened and become firm, rendering it of much value by its lateral pressure on the side of the trench. The closer the bulk of the materials can be packed into a given space, the less the quantity of lime required to bind them together.

The concrete used near London is composed of Thames' ballast, which contains about two of stones to one of sand, which proportion is found to be the most efficient and economical, wherever available, as the size of all the stones are nearly equal, being about the size of a 2 in. mesh; all that are larger than that dimension should be broken.

The lime should be hot from the kiln, or as fresh as possible, made from grey stone, and of the best quality, thoroughly burnt and ground, and should be, in quantity, proportionate to about one-half of the sand only. Thus we suppose the ballast to be two of gravel to one of sand; then two bushels of gravel, one bushel of sand, and half a bushel of lime, is the proper proportion, and will be found, when properly applied as before directed, perfectly satisfactory, where the Thames or other river ballast cannot be obtained. The surveyor or builder must make use of his own judgment to apportion the quantities according to the qualities, appertaining to the material to be obtained, and the quality and strength of the lime, so that the same satisfactory results may be obtained. This material may be used under water after it be set, and in tide ways.

When the stream is not very rapid, there is time, by working half tides, sufficient for its setting hard enough to resist any injury from the washing off the lime.

Wherever the concrete is required to be particularly solid, or where works of consequence are in course of construction, and where the foundations require the formation of a solid and compact mass, broken flints are recommended, as well as gravel; but in all cases where it is necessary to form the concrete impact, all round stones in the gravel or ballast should be broken; the greater the number of angles to the particles of matter to be mixed together, for the formation of the concrete, so much more will the mass increase in solidity and transverse strain. It is quite clear that no one would rely upon a concrete made of round stones like marbles, however good the lime and sand might be; therefore the more angular the large substance, the more secure and solid will the mass become. Concrete does not possess great strength when

exposed to transverse strain. Upon that subject we call attention to some interesting experiments, from the Papers of the Royal Engineers, by Lieut. Denison:—

The first experiment was made with the view of ascertaining whether a mass of concrete made with Aberthaw lime would resist the chemical action of water; for this purpose a small block, which had been prepared for nearly two years, was immersed for some time in distilled water, and upon applying the proper tests to the water it was found to have combined with a portion of the lime in the block Having mentioned this circumstance to Sir M. Faraday, he suggested it was probable the block contained a quantity of lime in an uncombined state, and recommended that it should be placed in a running stream for some time, in order to wash it thoroughly; this was accordingly done, by suspending the block for two months under a hulk in the river; after which, having again soaked it in distilled water for a week, hardly any trace of the lime could be detected in the water by the application of the most delicate tests. This experiment, then, appears to prove that concrete composed of proper materials, hydraulic lime and gravel, does not suffer by the chemical action of water. Experiment No. 2, was made in order to ascertain the strength of a block of concrete 2 ft. 6 in. long and 1 foot broad, and 1 foot 6 inches deep, which had been made for 2 years, and would have been used as a stretcher in the river wall at Woolwich.

A shackle was placed round the centre of the block, and two others at the extremities, at a distance of $11^1/_2$ in. each from the centre; a force being applied to the two ends and shackles by means of the hydraulic press, the block broke in the centre under a pressure of 4 tons 11 cwt. I did not prosecute the experiment upon the strength of this material any further, having sent down some blocks to Col. Pasley, R. E., who was investigating the same subject, and the results of whose experiments are as follow: Three stones, each 3 ft. long, and 18 in. wide, and 15 in. deep, were supported upon props 27 in. apart; weight being then applied to the centre of each, the first broke with 6,285 lbs., the second with 5,141 lbs., and the third with 2,930 lbs. This last had probably some flaw in it; taking therefore the mean of the two first only, the result will be 5,713 lbs. A piece of York paving $7^1/_2$ in. deep, 13 in. wide, and 27 in. between the supports, broke with the weight of 13,512 lbs. By these results it is found that concrete, to bear a transverse strain, as compared with York stone of the same area of section, is about in the proportion of one to thirteen.

At Woolwich the river wall is for the most part founded upon piles; its height above the piles is about 24 ft., thickness at bottom 9 ft., at top 5 ft., with a slope or batter in front of 3 ft. 22 in.: the face of this wall is composed of the above-mentioned blocks, which are laid in cement in courses 1 ft. 6 in. high, the headers and stretchers in the course being each 2 ft. 6 in. long, the former having a bed of 2 ft., while the latter have only 1 ft. behind the facing; the rough concrete is thrown in to complete the thickness of the wall and counter forts. Both the blocks and the rough concrete are composed of lime and gravel in the proportion of 1 to 7, and brought to the proper consistence with boiling water; but the blocks are, or ought to be, made with Aberthaw lime, while Dorking lime is used for the rest of the work. The blocks are cast in moulds, and are submitted to pressure whilst setting; a coating of finer stuff is given to the face for sake of appearance. The whole of the wall is built by tide work; and in the lower part, therefore, the backing of rough concrete has hardly time to set before it is covered by the tide; the water, however, in this instance appears to affect the surface of the mass only, the interior at the depth of a few inches being, generally speaking, dry, and of a moderate degree of hardness when examined after the retirement of the tide.

During the summer the action of the water from day to day upon the facing of the river wall was not perceivable; the surface still remained moderately hard; occasionally portions of the fine facing separated from the rest of the block, owing, it was said, sometimes to want of care in the original construction, sometimes to injuries by boats or vessels striking the wall. In these cases, however, a new facing of cement was applied, and before the winter the general appearance of the wall was, to a certain extent, satisfactory. During the hard frost, however, evidences of failure began to show themselves; and as soon as the thaw allowed a thorough inspection of the face of the wall to be made, it was found that hardly a single block had escaped without some damage. In many instances the whole face had peeled off to the depth of half an inch, and at one spot where a drain discharged itself into the river from a height of about six or eight feet, the back action of the water after its fall had worn away the lower course to the depth of some inches; these were the evidences of the action of frost and water combined upon the best constructed wall at Woolwich. At Chatham they were of the same character; but the damage done to the wall was much greater. The portion of the river wall at Woolwich, which was built with rough concrete, had been severely injured by the common action of the water before the frost; and the latter had only caused the destruction of the face to proceed with greater rapidity. Since the frost, I have examined the walls of a school near Blackheath, which was built with concrete some years ago: I found

that at the ground line where the drip of the water had acted, the concrete was soft, and yielded easily to any force applied, while the walls above were very fairly hard, and seemed to have stood very well.

These then are the facts I have to make known, and I think they afford sufficient grounds for asserting, that in climates like ours, in situations exposed to the alternate action of *water* and *air*, concrete cannot be advantageously used as a building material, the apparent economy, caused by the cheapness of the material employed, being more then compensated for by the frequency of repairs. From the circumstance that at Chatham some of the blocks remain apparently uninjured, whilst others, close to them, and exposed to exactly the same action, are completely decomposed, one would be tempted to infer that proper caution had not been used in the selection of the lime of which the latter were composed, and that, had Aberthaw lime been used throughout, the damage would not have been near so great; but even in this case, though the frost might not have produced so much effect upon the work, and should concrete be considered perfectly impervious to chemical action, yet the want of tenacity or of power to resist a very trifling force renders it peculiarly inapplicable to situations where, as in wharf walls, it will be exposed to the danger of the collision of vessels and floating bodies, in addition to the constant mechanical action of the water. Where, however, it is protected from these causes of destruction, as *in foundations, its value is unquestionable,* and even in the backing of retaining walls, revetements, etc., it may, in many cases, be advantaegously applied, taking care to allow it time to set before any great pressure is thrown upon the wall. The specific gravity of concrete is from 120 to 130, about the same as that of brick-work.

PLAN, ELEVATION, AND SECTIONS
OF ONE FOURTH-RATE HOUSE AND ADDITIONS.

See Plates 33, and 34.

Containing

One Cellar	22′ 8″ by 15′ 0″	and 6 ft. high	. . . . 2040 Cube ft.
One best Parlour .	15′ 0″ by 12′ 0″	9 ft. high	. . . . 1620 ditto.
One Front Parlour .	11′ 2″ by 9′ 8″ with folding doors	ditto	. . . . 972 ditto.
Lobby or Hall . .	13′ 0″ by 3′ 6″	ditto	. . . . 364 ditto.
Staircase and Passage	11′ 2″ by 5′ 0″	17′ 8″ high	. . . . 986 ditto.
Kitchen	15′ 6″ by 12′ 0″	9 ft. high	. . . . 1674 ditto.
Scullery	12′ 0″ by 8′ 0″	ditto	. . . . 864 ditto.
Closet	4′ 6″ by 3′ 0″	7 ft. high	. . . . 94 ditto.
Front Bed room . .	12′ 0″ by 12′ 0″	8 ft. high	. . . . 1152 ditto.
ditto ditto . . .	12′ 0″ by 11′ 2″	ditto	. . . . 1072 ditto.
Back ditto . .	15′ 0″ by 12′ 0″	ditto	. . . . 1440 ditto.
ditto ditto . . .	11′ 2″ by 9′ 8″	ditto	. . . . 864 ditto.

This convenient dwelling has been erected and finished complete in a workmanlike manner and with good materials, very lately, for the sum of three hundred pounds.

SPECIFICATION
OF WORKS PROPOSED TO BE DONE IN THE ERECTION OF ONE FOURTH-RATE HOUSE AND ADDITIONS.

Bricklayer. Dig out the foundations for all the walls and cellar, remove all rubbish not required, and carry up the walls, chimneys, etc., etc., with proper footings in good sound stock brickwork externally, and sound bricks within, with stone lime and sand of good quality, flushed in every course; turn internal arches over all lintels, dig to a proper depth, stein, and

dome in pump well and cesspools, provide curb for well if required, provide and lay in all drain pipes of 4 in. dia., glazed, with all proper bends and connexions, lay brick footings for sleepers of ground joists, turn all trimmers, set all the stoves, range, and copper, build up washhouse and privy, entrance passage and hall, and carry all necessary pipe drains to and from them; carry up the brick wall for iron palisade; fence with piers; put in coal shoot; core all the chimneys; provide and fix compo chimney-pots of approved pattern to all the flues, make good all putlog holes, bed and set all frames and sills, run all fillets in compo where required, point the whole of the fronts and returns, in white stuck pointing; pave the cellar washhouse and yard; slate the whole of the roofs with duchess slates, with proper painted fillets laid in putty, and metal nails; brick-nog all the partitions, and do all other work necessary to the completion of the whole of the buildings required hereto.

Carpenter. Put in proper bond, wood bricks, and lintels, to the whole of the buildings where required, also to the washhouse and privy; lay the ground-floor joists with proper sleepers and scantlings $4'' \times 3''$; the floor joists to be $7'' \times 2''$ herring bone strutted, the ceiling joists $4'' \times 1^1/_2''$ and part $5'' \times 1^1/_2''$, the plates, bond, etc. $4'' \times 3''$, the rafters $4'' \times 1^3/_4''$; frame all the floors and roofs, carry the rafters over the eaves to receive the zinc gutters; project the ridge of height sufficient to receive the slate fillets; put eave boards, and batten the whole of the roofs for slating, and lay the gutters behind all the chimneys; frame all the quarter partitions and truss heads over the folding doors, with scantling $4'' \times 3''$ the heads $4'' \times 4''$; lay all the floors with 2 cut white spruce battens prepared and laid folding. Skirt all the upper floors with $^3/_4$ square batten, the lower floors and hall with 12″ moulded skirting, the kitchen with 9 in. $^3/_4$ plain; board over the ceiling joists in roof with half inch boards prepared; make trap door and step ladder to ditto from staircase, and trap door and frame to roof; prepare and fix the whole of the deal cased sash-frames with oak sunk, sills, and $1^1/_2$ in. ovolo sashes double hung, with lines, weights, and proper fastenings; prepare and fix the whole of the doors throughout the buildings, the upper floor and closets of $1^1/_4$ in. deal four pannel square, and the lower floor of six pannel $1^1/_2$ ditto moulded on both sides, the back doors and outer doors of 4 pannel bead butt; the front door 2 in. moulded door with fan light, as per drawing; the folding and parlour doors of 2 in. 6 pannel moulded on both sides, and hung with rising butts to lift; the others all to be fitted and hung with 3 in. butts and screws, and the whole with proper rebated jaumbs, grounds, linings, and architraves moulded and properly fixed; prepare and fix proper solid rebated frames with oak sills to all the outer doors, washhouses, and privy; the back and front doors to be sashed, and with shutters; prepare and fix the proper staircase with mahogany hand rails, $1^1/_4''$ treads, inch risers moulded and returned and housed into $1^1/_4''$ string boards, with proper carriages, and moulded spandril, with door and frame hung to cellar with flight of stairs housed into $1^1/_4$ strings to the same; prepare and fix proper moulded sash shutters hung, with backs, linings, and architraves to the parlour windows, all properly hung with patent lines and weights, and bead butt shutters properly hung to the kitchen windows and washhouse; prepare and fix proper framed closet fronts with doors and shelves, pegs, etc., to the bed rooms. No 4. linings and architraves where necessary; fix a proper 5 feet dresser with shelves, potboard, and two drawers, in kitchen; floor and skirt privy, and fix proper seat and riser, with flap hung, and box line the pipes; prepare and fix an inch deal cistern of size shown in drawing over the privy, and of approved depth; fix a strong pump frame prepared of 3 in. yellow deal and small inch deal cistern complete; put wood cover and cowl to copper, and spout to ditto from the pump; make good all linings required to windows, doors, stairs, or elsewhere; put 6″ knob locks to all the upper doors, and locks to closets, 6″ mortice-locks with white porcelain furniture and finger-plates to parlours, 8 in. draw back ditto to front and back doors, and proper brass sash and all other fastenings, bolts, bars, finger-plates, etc., etc. required throughout the buildings, and do all the carpenter's and joiner's work required to

complete the whole of the buildings, washhouses, and privy, and find all materials necessary, the timber to be of approved Dantzic, or best red pine.

Plasterer. Run a bed moulding, to be approved, under the soffet of the projection of roof, and two ornamental trusses in front, to receive the end of the cornice and front gutter; run compo architrave, facings with cornice trusses and labyle heads, to all the front windows and doors, as per drawing; run cornice or coping to the end of additional building; compo the reveals of all the windows and doors; run coping or cornice over the front entrance door and make good to all outer work in cement; lath, render and set all the ceilings and partitions required; render and set the whole of the walls and partitions; float and lay the two parlours, and run cement angle staff to chimney breasts rounded; run a cornice to the parlour as per drawing, and ditto to the hall; whiten all the ceilings, color walls, lime white cellar, plaster privy and washhouse, and make good to all work, providing materials, and do every thing necessary to complete the whole of the buildings.

Mason. Provide and fix proper rubbed York sunk and throated sills to all the front windows, tooled York to all the back ditto, one solid step sill and 6 ft. superficial of paving to the front door, two stone constructions to upper chimneys, thirty feet run of canted curb, with holes cut for palisade fence 6><4 with block stones for braces, and wide gate stones, two stone caps for piers complete; provide and fix two box marble chimneys, at cost price 50*s* each, 2 box stone ditto, two plain ditto, and one set of kitchen jaumbs and mantle complete, 9 in. wide, with inner and outer hearths to the whole, properly cramped and fixed with shelves complete, one 30 in. York sink, five hole sink stones, one piece of York paving to the back door, and ditto to washhouse and privy, and provide all materials and do all mason's work required to complete the buildings.

Blacksmith. Provide and fix thirty feet of cast-iron approved pattern palisade fence, with wrought iron rails and proper gate hung, with lock and braces to rails, all run with lead; provide all chimney bars, hoop bond, and ties, two 36 in. register stoves, two thirty inch ditto, and two smaller ditto, not to exceed 7^{d} per in., one 18 inch copper and ironwork complete, and provide all materials and do all smith's work required in the buildings.

Plumber. Line the cistern with stout 18 oz zinc, put in supply pipes and cocks to water cistern and sink, and waste pipe with stink trap to ditto; provide and fix syphon pan closet complete, and connect with pipe and cock to cistern of pump, provide and lay the zinc gutters of roof two feet wide, the same to chimney with flashings, fix the O G and other gutters with stack pipes, shoes, and cistern heads required, to convey water to cistern from all the building; provide lead to run in the ironwork of fence: provide and fix one 3 in. barrel lead pump with additional cistern, lead pipe, and cock to water closet, and pipe to well and ironwork complete, and find all material and do all plumber's work required in or upon the buildings.

Painter. Paint the whole of the outside and inside wood iron and zinc work four times in oil; properly colour or paint with Emmerson's patent paint, or other approved pigment, the whole of the compo and cement work; grain and twice varnish the two parlours, the hall staircase and also the outer front door and sashes, in any approved imitation of wood, and properly varnish the paper of hall, passage, and stairs, the whole of the work to be properly stopped and rubbed down; paint the slate fillets of roof, and find all paint and work required; provide and hang with approved paper, to average 2*s* 6*d* per piece cut close, the whole of the walls and partitions required; glaze the whole of the windows and doors with the best crown glass, clear and of good colour, and perform all plumbing, glazing and painting, as well as paper hanging and materials, to completely finish the whole of the buildings.

All the materials used in the erection of the said works to be approved by, and all the works specified to be done, to the satisfaction of the Surveyor, within four months.

The full intent and meaning of this specification is, to provide for finishing the whole of the works to the house, additional buildings, and offices fit for habitation; and should any other works or materials not herein mentioned be required, or found necessary to the completion of the same, they are to be provided for, and specified in the Estimates, and included therein by the contractor, for no extra work will be allowed.

The whole of the buildings to be erected in conformity to the building act, and the district surveyor's fees to be paid by the contractor.*

I hereby agree to perform the whole of the works specified herein and complete the whole of the works herein contained, and intended to be done, and that may be required, to finish the whole of the Buildings for the sum of £ —

QUANTITIES

OF A FOURTH-RATE HOUSE AND ADDITIONS.

EARTH WORK. SEE PLATES 33, AND 34.

EXCAVATIONS.

No.	ft. in	ft. in.	ft. in.		
1	25 „ 0	17 „ 6	7 „ 6	= 3282	Cellar.
1	25 „ 0	3 „ 0	2 „ 0	= 150	Back wall.
2	12 „ 0	3 „ 0	2 „ 0	= 144	Flanks to ditto.
1	14 „ 0	3 „ 0	2 „ 0	= 84	Entrance hall.
1	1 „ 0	9 „ 6	6 „ 0	= 57	Well.
1	11 „ 0	1 „ 6	2 „ 0	= 33	Offices.
1	25 „ 0	2 „ 0	2 „ 0	= 100	Drains.
1	30 „ 0	1 „ 6	1 „ 0	= 45	Fence wall front.
2	3 „ 6	3 „ 0	2 „ 0	= 42	Returns of hall.
				3937 Cube feet.	
				$145^{27}/_{22}$ Cube yards.	

BRICKWORK.

FOOTINGS.

			half Bricks in thickness.		
2	25 „ 0	0 „ 6	$4^1/_2$	= 112 „ 6	Footings deep wall.
2	15 „ 0	0 „ 6	$4^1/_2$	= 67 „ 6	Ditto flanks.
4	1 „ 6	0 „ 6	$4^1/_2$	= 13 „ 6	Chimney jaumbs.
1	25 „ 0	0 „ 6	$4^1/_2$	= 56 „ 3	Back wall.
2	12 „ 0	0 „ 6	$4^1/_2$	= 54 „ 0	Sides to ditto.
1	14 „ 0	0 „ 6	$4^1/_2$	= 31 „ 6	Entrance hall.
1	11 „ 0	0 „ 6	4	= 22 „ 0	Offices.
1	30 „ 0	0 „ 6	4	= 60 „ 0	Front fence wall.
1	9 „ 0	6 „ 0	1	= 54 „ 0	Well.
2	3 „ 6	0 „ 6	4	= 14 „ 0	Returns of hall.
				485 „ 3 Cube feet.	Carried forward.

* Where the Building is not within any district of the Metropolitan Building Act, leave this clause out.

WALLS.

Brought forward 485 „ 3

No.	ft. in.	ft. in.	half Bricks in thickness.		
2	25 „ 0	7 „ 6	3	1125 „ 0	Front and middle cellar walls.
2	15 „ 0	7 „ 6	3	675 „ 0	Sides or flanks.
1	4 „ 0	7 „ 6	3	90 „ 0	Chimney-breasts.
1	5 „ 0	7 „ 6	3	112 „ 6	Ditto.
1	25 „ 0	2 „ 6	3	187 „ 6	Back wall.
2	12 „ 0	2 „ 6	3	180 „ 0	Sides to ditto.
1	14 „ 0	2 „ 6	3	105 „ 0	Hall.
2	3 „ 6	2 „ 6	3	52 „ 6	Returns of ditto.
1	11 „ 0	1 „ 6	3	44 „ 0	Private offices.
1	4 „ 6	1 „ 6	3	20 „ 3	Copper, etc.
1	3 „ 6	1 „ 6	3	15 „ 9	Corner chimney.
3	25 „ 0	17 „ 6	2	2625 „ 0	Back, front, middle walls.
2	26 „ 6	17 „ 6	2	1855 „ 0	Flanks to ditto.
2	4 „ 6	17 „ 6	2	315 „ 0	Chimney-breasts.
2	4 „ 0	17 „ 6	2	280 „ 0	Ditto, Back.
1	14 „ 0	9 „ 6	2	266 „ 0	Hall.
2	3 „ 6	9 „ 6	2	133 „ 0	Returns of ditto.
1	11 „ 0	8 „ 0	2	176 „ 0	Offices.
2	2 „ 9	8 „ 6	5	233 „ 9	Chimney shafts.
2	2 „ 9	2 „ 3	5	65 „ 11	Back ditto.
1	30 „ 0	1 „ 6	2	90 „ 0	Fence wall.

9132 „ 5
Deductions 786 „ 6

3) 8346 „ 5 half Brick thick.

2782 $1^1/_2$ Brick thick.

rods ft.
272)2782(10 „ 62 $1^1/_2$ Brick-work.
272
..62

DEDUCTIONS.

2	5 „ 6	4 „ 6	2	99 „ 0	Parlor windows.
2	4 „ 6	3 „ 6	2	63 „ 0	Front upper windows.
3	4 „ 6	3 „ 6	2	94 „ 6	Back windows.
2	7 „ 6	3 „ 0	2	90 „ 0	Back and front-hall doors.
4	6 „ 6	3 „ 0	2	156 „ 0	Back door and door in middle wall. Side ditto up-stairs.
1	8 „ 0	3 „ 0	2	48 „ 0	Staircase window.
2	2 „ 6	5 „ 6	3	82 „ 6	Chimney basement jambs.
3	3 „ 0	3 „ 0	3	81 „ 0	Chimney ground-floor.
4	3 „ 0	2 „ 0	3	72 „ 0	Ditto, upper floor.

786 „ 0 half Brick thick.

TIMBER.

CARPENTER'S WORK.

FIR FRAMED.

No.	ft. in.	ft. in.	ft. in.		
114	0 .. 9	0 .. 4	0 .. 3	9 .. 0	Wood bricks.
4	5 .. 6	0 .. 4	0 .. 3	1 .. 10	Lintels Front.
9	4 „ 6	0 „ 4	0 „ 3	3 „ 5	Ditto door, etc., and back and middle.
6	24 .. 0	0 „ 4	0 .. 3	12 „ 0	Front bond.
4	28 „ 0	0 „ 4	0 „ 3	9 „ 4	Returns to ditto.
6	24 „ 0	0 „ 4	0 .. 3	12 .. 0	Plate for joists.
4	28 „ 0	0 .. 4	0 .. 3	94 .. 0	Returns to ditto.
12	24 „ 0	0 .. 7	0 „ 2	28 .. 0	Ground-floor joists, front.
10	15 „ 8	0 .. 7	0 .. 2	15 .. 3	Ditto to kitchen.
24	24 „ 0	0 .. 7	0 „ 2	50 „ 0	Upper-floor joists.
Note. Less 6 ft. well-hole stairs.					
2	11 .. 9	0 „ 4	0 „ 4	2 .. 7	Head and sill of partition next stairs, ground-floor.
4	9 .. 0	0 „ 4	0 .. 3	3 .. 0	Main posts.
5	9 .. 0	0 .. 4	0 „ 2	2 .. 6	Quarters to ditto.
1	6 .. 0	0 .. 4	0 „ 3	0 .. 6	Door head and muntens.
2	11 .. 9	0 .. 4	0 .. 4	2 .. 8	Head and sill of upper ditto.
4	8 .. 6	0 .. 4	0 .. 3	2 .. 10	Main posts of ditto.
5	8 .. 6	0 .. 4	0 „ 2	2 .. 4	Quarters ditto.
1	6 .. 0	0 .. 4	0 „ 3	0 .. 6	Door head and muntens.
2	15 .. 6	0 „ 4	0 „ 4	3 „ 5	Head and sill cross partition.
6	9 .. 0	0 .. 4	0 „ 3	4 .. 6	Main posts.
2	9 .. 0	0 .. 4	0 „ 2	1 „ 0	Quarters.
5	1 .. 9	0 .. 4	0 .. 2	0 .. 6	Muntens over folding-doors.
1	6 .. 0	0 .. 4	0 „ 4	0 .. 8	Head truss.
1	7 „ 0	0 „ 4	0 .. 3	0 „ 7	Trusses to ditto.
1	10 .. 0	0 .. 4	0 .. 3	0 .. 10	Door head and muntens.
2	15 .. 6	0 .. 4	0 „ 4	3 „ 5	Head and sill upper partitions.
5	8 „ 6	0 „ 4	0 .. 3	3 .. 7	Main posts.
8	8 „ 6	0 „ 4	0 .. 2	3 .. 9	Quarters.
2	8 „ 0	0 .. 4	0 .. 3	1 .. 4	Braces.
1	10 „ 0	0 .. 4	0 .. 3	0 .. 10	Door head and muntens.
2	12 „ 8	0 „ 4	0 .. 3	2 .. 2	Head and sill, kitchen partition.
10	9 „ 0	0 „ 4	0 .. $2\frac{1}{2}$	6 „ 3	Quarters and posts to ditto, including door head.

HALL.

4	13 .. 0	0 „ 7	0 .. 2	5 .. 1	Joists in hall.
4	13 .. 0	0 .. 4	0 .. $1\frac{1}{2}$	2 .. 5	Ceiling joists to hall.
2	13 „ 0	0 .. 4	0 „ 3	2 .. 2	Roof plates.
				294 .. 3	Carried forward.

Brought forward 294 „ 3

No.	ft. in.	ft. in.	ft. in.			
2	4 „ 0	0 „ 4	— „ 3		— „ 8	Returns of ditto.
12	4 „ 6	0 „ 4	— „ $1^3/_4$		2 „ 8	Rafters of ditto.

ROOF OF MAIN BUILDING.

3	24 „ 0	0 „ 4	0 „ 3		6 „ 0	Back, front, and middle wall.
2	28 „ 0	0 „ 4	0 „ 3		4 „ 8	Flanks to ditto.
20	15 „ 6	0 „ 5	0 „ $1^1/_2$		13 „ 6	Front ceiling joists.
20	12 „ 6	0 „ 4	0 „ $1^1/_2$		10 „ 5	Back ditto.
40	10 „ 0	0 „ 4	0 „ $1^3/_4$		19 „ 6	Front rafters, front building.
40	7 „ 6	0 „ 4	0 „ $1^3/_4$		14 „ 7	Back rafters, back building.
2	25 „ 6	0 „ 6	0 „ $1^1/_2$		3 „ 2	Ridge boards.
54	1 „ 0	0 „ $^3/_4$	Sup.		3 „ 3	Gutter boards.
24	24 „ 0	0 „ 2	0 „ $^3/_4$		6 „ 8	Slating battens.
					379 „ 4	
1	16 „ 0	0 „ 7	0 „ 2	deduct	1 „ 7	
						377 „ 9 Cubic ft.

JOINER.

1	23 „ 6	15 „ 0	Sup.	352 „ 6	Wrought floor cock loft.
2	23 „ 6	15 „ 0		705 „ 0	2 Cut batten floors of front buildings.
1	23 „ 6	12 „ 0		282 „ 0	Ditto upper floor of back buildings.
1	15 „ 3	12 „ 0		183 „ 0	Ground floor of kitchen.
1	12 „ 6	3 „ 6		43 „ 9	Entrance hall.
1	4 „ 6	2 „ 9		12 „ 5	Ditto of W. C.
				1578 „ 8	
				58 „ 8	
				1520 „ 0	
	Deductions.				1520 Square feet.
2	3 „ 6	5 „ 0	Sup.	35 „ 0	Stairs.
7	4 „ 6	0 „ 9	do.	23 „ 8	Chimney-breasts.
				58 „ 8	

SASH SHUTTERS.

2	6 „ 9	5 „ 6	Sup.	74 „ 3	Sash shutters moulded and hung, including boxing linings and architraves.
1	4 „ 6	3 „ 0	do.	13 „ 6	Bead butt shutters hung.

SKIRTING.

4	23 „ 6	0 „ 7	Lineal	94 „ 0	Square skirting top floor.
4	15 „ 0	0 „ 7	do.	60 „ 0	Ditto.
4	12 „ 0	0 „ 7	do.	48 „ 0	Ditto.
				202 „ 0	Carried forward.

No.	ft. in.	ft. in.			
			Brought forward	202 „ 0	
2	7 „ 6	0 „ 7	Lineal	15 „ 0	Stairs.
2	15 „ 3	0 „ 9	do.	30 „ 6	Kitchen.
2	12 „ 0	0 „ 9	do.	25 „ 0	Ditto.
1	9 „ 0	0 „ 4	do.	9 „ 0	Privy.
				281 „ 6	
				26 „ 0	
	Deductions.			257 „ 6 Lineal.	
1	12 „ 0	0 „ 7	Lineal	12 „ 0	Upper doorways.
1	14 „ 0	0 „ 7	do.	14 „ 0	Upper chimneys.
				26 „ 0	

MOULDED SKIRTING.

3	23 „ 6	1 „ 0	Lineal	70 „ 6	Ground-floor.
4	15 „ 0	1 „ 0	do.	60 „ 0	Ditto.
2	12 „ 6	1 „ 0	do.	25 „ 0	Hall.
				155 „ 6	
				41 „ 0	
	Deductions.			114 „ 6 Lineal.	
1	27 „ 0	1 „ 0	Lineal.	27 „ 0	Lower floor doors and folding ditto.
1	14 „ 0	1 „ 0	do.	14 „ 0	Chimneys.
				41 „ 0	
1	Twelve step Ladder			12*s.*	

SASHES AND FRAMES.

2	5 „ 9	3 „ 6	Sup.	40 „ 3	Front sashes and frames.
2	4 „ 9	3 „ 6	do.	33 „ 3	
3	4 „ 6	3 „ 0	do.	40 „ 6	Back windows.
1	7 „ 0	2 „ 6	do.	17 „ 6	Staircase.
				131 „ 6 Sup.	

FRAMED DOORS

8	6 „ 3	2 „ 6	Sup.	125 „ 0	1¼″ Square.
4	6 „ 8	3 „ 0	do.	80 „ 0	1¾″ Double moulded.
2	6 „ 3	2 „ 6	do.	31 „ 3	1¼″ Bead butt.
1	6 „ 8	3 „ 0	do.	20 „ 0	2 in. Front double moulded.
1	6 „ 0	6 „ 8	do.	40 „ 0	2 in. Folding ditto.
1	Solid rebated frame and Fanlight			£ *s.* *d.* 1 „ 12 „ 6.	

GROUNDS, JAMBS, AND ARCHITRAVES.

8	15 „ 0	0 „ 6	Lineal	120 „ 0	Upper floor doors.
4	16 „ 6	0 „ 6	do.	66 „ 0	Ground ditto.
1	19 „ 0	0 „ 6	do.	19 „ 0	Folding doors.
				205 „ 0 ft. Lineal.	

STAIRCASE.

No.	ft. in.	ft. in.				
1	7 „ 6	3 „ 0	Sup.	22 „ 6		Treads inch deal returned nosings.
1	5 „ 6	3 „ 0	do.	16 „ 6		Ditto.
1	9 „ 0	3 „ 0	do.	27 „ 0		Inch risers.
1	24 „ 0	1 „ 0	do.	24 „ 0		$1^{1}/_{4}$ Housed strings.
1	7 „ 6	2 „ 6	do.	18 „ 9		$1^{1}/_{4}$ Cellar door and frame.
1	5 „ 0	3 „ 6	do.	17 „ 6		$1^{1}/_{4}$ Framed and moulded spandril.
1	7 „ 6	2 „ 6	do.	18 „ 9		1 in. Housed cellar stairs.
					145 „ 0	

2 Turned newels 12 ft.
Mahogany handrail 10 ft.
2 Caps, 2 ramps.
10 ft. Capping to strings.
26 — 1 — $^{3}/_{4}$ Balusters.

PLASTERER.

CEMENT.

1	24 „ 0	1 „ 0	Sup.	24 „ 0		Run cornice in cement.
1	24 „ 0	1 „ 0	do.	24 „ 0		Architraves and reveals to top windows.
	28 „ 0	1 „ 0	do.	28 „ 0		Ditto with lable heads and 4 console trusses.
	18 „ 0	1 „ 0	do.	18 „ 0		Plain face compo to entrance.
	4 „ 6	1 „ 6	do.	7 „ 4		Cornice to ditto.
					101 „ 4	

LATH PLASTER.

2	27 „ 0	23 „ 0	Sup.	1242 „ 0	Lath render set ceilings.
2	17 „ 0	22 „ 0	do.	748 „ 0	Back partitions ditto.
1	12 „ 0	3 „ 0	do.	36 „ 0	Porch ditto.
2	17 „ 0	15 „ 0	do.	510 „ 0	Front partition.
	4 „ 6	3 „ 0	do.	13 „ 6	Privy ditto.
				2549 „ 6	
				132 „ 10	
				2416 „ 8	

$268^{4}/_{9}$ Sup. yards.

DEDUCTIONS.

4	3 „ 0	7 „ 0	84 „ 0	Doors in lath lay and set.
1	6 „ 8	7 „ 4	48 „ 10	Folding doors.
			132 „ 10	

RENDER AND SET.

4	27 „ 0	17 „ 0	Sup.	1836 „ 0	Render and set to front wall and back.

1836 „ 0 Carried forward.

Brought forward 1836 „ 0

No.	ft. in.	ft. in.			
4	23 „ 0	17 „ 0	Sup.	1564 „ 0	Do. flank wall.
—	30 „ 0	9 „ 0	do.	270 „ 0	Do. porch.
1	12 „ 0	7 „ 0	do.	84 „ 0	Privy.
				3754 „ 0	
				383 „ 0	
				3371 „ 0 = 373 5/9 Sup. yards.	

DEDUCTIONS.

7	5 „ 0	4 „ 0	Sup.	140 „ 0	Windows, render and set.
9	7 „ 0	3 „ 0	do.	189 „ 0	Doors ditto.
6	3 „ 0	3 „ 0	do.	54 „ 0	Chimneys ditto.
				383 „ 0 Sup. feet.	
4	17 „ 0	Lineal		68 Lineal feet.	Angle staff in cement.
2	12 „ 0	1 „ 0	Sup.	24 „ 0	Cornice.
2	15 „ 0	1 „ 0	do.	30 „ 0	Ditto.
2	11 „ 0	1 „ 0	do.	22 „ 0	Ditto.
2	10 „ 0	1 „ 0	do.	20 „ 0	Ditto.
2	12 „ 6	1 „ 0	do.	25 „ 0	Ditto hall.
2	4 „ 0	1 „ 0	do.	8 „ 0	Ditto ditto.
				129 „ 0 = 129 „ 0 Sup. feet girth.	
Extra Mitres No. 8					

WHITEN.

2	24 „ 0	27 „ 0	Sup.	1296	Whitewashing ceilings.
2	22 „ 6	6 „ 0	do.	270	Lime white.
2	15 „ 0	6 „ 0	do.	180	Ditto.
1	30 „ 0	0 „ 8	do.	20	Cornice to hall.
				1766 = 196 2/9 Sup. yards.	
2	Console Trusses			12s.	

MASON.

20 Run rubbed york throated sills.
18 „ 0 Tooled ditto.
6 „ 0 Super 3 inch paving.
30 „ 0 Run, canted curb with holes cut 6 × 4.
2 Stone corbels.
2 Block stones.
12 Ft. Super York paving in gate stone.
2 — 4 in. Saddle backed caps for piers 1′ „ 6″ × 1′ „ 6″.
2 Box marble chimney pieces, cost price 50/ ea.
2 Box stone ditto.
2 Plain ditto.
1 Set 9 in. kitchen ditto, with inner and outer hearths to the whole.

1 — 30 in. York sink.
2 — 5 Hole sink stones.
18 Ft. Supl. 2 in. York paving.

BLACKSMITH.

30 Ft. Cast iron palisade fence with gates fixed.
4 Chimney bars.
28 Pounds of hoop iron for bond.
2 — 36 in. Register stoves.
2 — 30 in. Register ditto.
2 — 24 Ditto ditto.
1 — 18 in. Copper and ironwork.

PLUMBER.

32 Ft. Super zinc lining to cistern 18 oz. } 71 ft. super.
39 Ft. Ditto ditto in gutter ditto. }
20 Ft. of $^3/_4$" lead pipe.
1 Brass cock.
Fix a siphon closet complete.
54 Ft. of 6 in. O G zinc gutter.
24 Ft. of ditto half round ditto.
10 Ft. of 2 in. stack pipe with head and shoe.
$^1/_4$ Cwt. Lead for front fence.
$2^1/_2$ in. Barrel lead pump complete.
1 Cistern head pipe and cock to water closet.

PAINTER.

168 Yards painting 4 coats in oil.
8 Doz. sashes.
9 Frames.
12 Yards sup. cement patent paint.
56 Yards sup. of grain and varnish.
36 Pieces of paper at 2*s.* per piece hung.
☞ Note. Include the glazing in sashes and frames.

MISCELLANEOUS.

34 Ft. Supl. inch deal	Pump cistern.
5 Number of	Proper solid door frames, oak sills.
1 Number of	Proper pump frame.
9 Ft. Supl. inch deal	Service cistern.
6 Ft. $4^1/_4$ in arris gutter	Arris gutter to copper.
1 Number of	Proper 5 ft. dresser, drawers, pot board and shelves.
16 „ 6 ft. Sup. inch deal	Seat and riser, floor, closet and lining to pipes.

4 = 6 in. Iron rimmed locks.
4 = 4 in. Closet ditto.
3 = 6 in Mortice ditto with porcelain furniture
8 = Finger plates.
3 = 8 in. Draw back locks.

6 = 8 In rough rod bolts.
1 = Knocker.
2 = Scrapers.
8 = Compo chimney pots, No. 3.
1 = Copper lid and stick.
80 Ft. 4 inch. glazed drain pipe.
1 Siphon bend and one quadrant ditto.

SUMMARY OF QUANTITIES
OF A FOURTH-RATE HOUSE AND ADDITIONS.

SEE PLATES 33, AND 34.

yard.	ft.	in.					
145	17	—	Cubic yards excavation earth work.				
10	62	—	Rods brickwork reduced.				
	377	9	Cubic feet fir framed.				
15	20	—	Square 2″ cut batten flooring.				
	74	3	Supl. sash shutters, moulded one side and hung, including boxing lines, stiles, and architraves.				
	13	6	Supl. $1^1/_4$ bead butt shutters hung.				
	257	6	Lineal $^3/_4$ square batten skirting.				
	114	8	Supl. moulded skirting double face.				
			One 12 step ladder.				
	131	6	Supl. ovolo sashes and frames.				
	125	—	Supl. $1^1/_4$ square doors 4 panel.				
	80	0	Supl. $1^3/_4$ double moulded.				
	31	3	Ditto $1^1/_4$ bead butt.				
	20	0	Ditto 2 front door moulded and flush.				
	40	0	Ditto 2 double moulded folding.				
			One solid rebated frame and fanlight.				
	205	—	Feet lineal grounds, jambs, and architraves.				
	145	6	Sup. $1^1/_4$ and inch proper staircase.				
			Two turned newels.				
	10	0	Ft. lineal mahogany handrails.				
			Two caps, two ramps.				
	10	0	Lineal capping to strings.				
26	—	—	Number of $1^3/_4$ balusters.				
	101	4	Supl. cement cornice and dressings.				
268	4	0	Supl. yards lath, plaster, and set.				
374	5	0	Supl. yards render and set.				
	68	0	Lineal angle staff in cement.				
	129	0	Ditto feet cornice.				
			Eight extra mitres.				
196	0	0	Supl. whiten = 2 console trusses.				

yards.	ft.	in.	Brought forward				
196	2	0	Whiten ceilings and cornices.				
	20	0	Lineal rubbed York throated sills.				
	18	0	Ditto tooled.				
	6	0	Supl. 3 inch paving.				
	30	0	Lineal canted curb with holes cut 6><4.				
			Two stone corbels.				
			Two block stones.				
	12	—	Supl. York paving in gate stone.				
			Two 4 in. saddle backed caps for piers 1—6><1—6.				
			Two box marble chimney pieces cost price 50/ ea.				
			Two box stone ditto.				
			Two plain ditto.				
			One set 9 in. kitchen ditto, with inner and outer hearts to the whole.				
			One 30 in. York sink.				
			Two 5 hole sink stones.				
	18	0	Supl. 2 in. York paving.				
	30	0	Lineal iron palisade fence with gates fixed.				
			4 chimney bars.				
	28	0	Pounds of hoop iron for bond.				
			Two 36 in. register stoves.				
			Two 30 in. ditto.				
			Two 24 in. ditto.				
			One 18 in. copper and ironwork.				
	32	0	Supl. zinc lining to cistern 18 oz.				
	39	0	Ditto in gutter ditto.				
	20	0	Lineal 3/4 lead pipe.				
			One brass cock.				
			Fix a syphon closet complete.				
	54	6	Lineal 6 in. O G zinc gutter fixed.				
	24		Ditto feet of ditto half round ditto.				
	10		Ditto feet of 2 in. stack pipes with head and shoe.				
1/4			Cwt. lead for front fence.				
1	—	—	2 1/2 in barrel lead pump complete.				
1			Cistern head pipe and cock to water-closet.				
168	0	0	Supl. yards 4 coats oil.				
8	--	—	Dozens of sash squares.				
9	—	—	Number of sash frames painted.				
12	0	0	Supl. cement patent paint.				
56	0	0	Ditto yards grain and varnish.				
36	0	0	Number of pieces of paper at 2s. 6d hung.				
			☞ Note. Include the glazing in sashes and frames.				
			MISCELLANEOUS.				
	34	0	Supl. feet, inch deal cisterns.				
5	„	„	Number of proper solid door frames oak sills.				
			Carried forward £				

yards.	ft.	in.	Brought forward				
			One pump frame.				
	9	0	Supl. inch deal.				
	6	0	Lineal ft. $4^1/_2''$ arris gutter.				
			One proper 5 ft. dresser drawers and shelves.				
	16	6	Supl. ft. inch deal seat, riser, etc.				
			Four 6 in. iron rim locks.				
			Four 4 in. closet ditto.				
			Three 6 in. mortice ditto, porcelain furniture.				
			Eight porcelain finger plates.				
			Three 8 in. draw-back locks.				
			Six 8 in. rough rod bolts.				
			One rapper.				
			Two scrapers.				
			Eight compo chimney-pots.				
			One copper lid and stick.				
	80	0	Lineal feet 4 in. stone drain pipes.				
			One syphon bend, one quadrant ditto, one junction.				

No estimate is intended for these quantities; the amount it costs in erection is stated in the description; any person can fill in according to the price of material in the locality; to put a sum would perhaps mislead; the quantities are the essential knowledge required, and prices alter very materially.

BRICKWORK

In the formation of brickwork, particular care should be taken to insist upon the joints being invariably broken, that is, that every brick should lie over the joints or intersections of the bricks in the course immediately below the one in course of erection, so that no part of the wall can separate from the other; this is called bond or bonding many small pieces together, to make one integral whole. Again, in footings, where the bottom courses project to obtain a larger surface or base for the support of the superincumbent weight of the walls purposed to be carried up, no stretcher should be laid in any outer course where it can be avoided, for in such case the one half of the stretcher only can assist in bearing the weight, although the other half assists so far as the transverse tension of the brick to add to the support of the upper weight; but if all headers be laid, three-fourths of the brick are under the actual pressure of the upper work. Plate 6, Fig. 1, gives a footing of four bricks wide laid with all headers: the dotted lines describe the next ascending course of three and one half bricks, but laid with one stretcher alternate with every two headers but the stretchers inside, and shewing that every intersection of the lower course is covered by the one above it; and thus an equal and continuous bearing extends throughout. Plate 6, Fig. 2, shews the dotted course of Fig. 1, Plate 6, of three and one half bricks laid down, and the dotted lines upon that indicate the upper course immediately underneath them, and given, as before, the set off on each side of $2^1/_4$ inches; Fig. 3, Plate 6, describes the last course

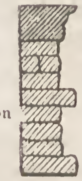
of three bricks laid down, and the dotted lines upon that again shew the upper course of two and one half bricks laid with all headers outside, and a course of stretchers in the middle, every intersection of the lower course being covered as before; Fig. 4, Plate 6, gives the two and one half course laid down as before, and dotted to indicate the position of the course of two bricks above it, still covering or breaking joint with every intersection below. In Fig. 5, Plate 7, the two-brick course is laid down with the dotted lines indicating the one and one half brick course as laid upon it, with the same care made use of to cover the meeting joints below; in the first course of one and one half brickwork it should be carried as shewn in the plan, one stretcher and two headers alternately all through the work. Fig. 6, Plate 7, gives also the first course of nine-inch work carried with headers all through; Fig. 8, Plate 7, is a section of all the preceding courses of footings, shewing the regular breaking of the joints and their equal bearing throughout. Brickwork to face walls is carried up, in some cases, with what is called old English bond, being one course all headers throughout followed by a course of all stretchers. The quoins must be started with a $^3/_4$ brick or a closer, the stretching course binding the parts of the wall together longitudinally, while the heading courses perform the same duty in the transverse direction; this method produces a structure of great strength, and rarely is found to separate at the joints, but assimilates to one solid mass (see Plate 7, Figs. 9 & 10). Another method, and most generally now in use, is called Flemish bond, and the face work is carried up by laying the bricks throughout in the same course, alternately a header and a stretcher; but in starting at the quoins a quarter brick or closer must be introduced to break the joint, or the purpends will form one joint over the other, which must not be allowed to happen (see Plate 9, Fig. 4). Again, in Flemish bond, the face of the wall is carried up with more expensive bricks, and the headers, to save the more valuable bricks are only worked in one half brick, and the outside four and half inches of the front of the wall have barely any tie by the headers on to the nine inch work behind; in such case, walls frequently bulge forward, indeed they become as two walls built against each other, one of four, another of nine, and no tie between them; this is a very sad fault, and great care must be taken in all cases to avoid it.

The principal care in carrying up face walls is, as a matter of course, bestowed upon that face, or the outside; but the workmen carrying up the back should be careful to well bind the whole, and care should also be bestowed to see that every front header should be a whole brick; also let every space be filled up with pieces of brick, and every course flushed in with mortar thrown heavily from the trowel; counter arches should be turned over all window and door openings (see Plate 9, Fig. 2); and if any large openings be in the basement, inverted arches should be introduced (see Plate 9, Fig. 3), but not if the opening be near the quoin of the work. In putting in guaged arches, the bricks should be well soaked in water, and the joint neatly cut; in bedding plates and bond, the mortar should not be too stiff. Again, in one brick work, bond timber is not allowed; and iron hoop bond across any opening is useless, although very useful to tie one wall to another; but as in nine inch work stiffness is required across the openings to steady the piers, put in bond timber thus, cut the bond to one foot 6 inches more than the opening required, take a piece of stiff iron hoop the exact length that the pier is wide, bed the wood bond across the opening, resting nine inches on the pier on each side of the opening, then nail or screw the iron hoop on to the nine inches of the bond in the wall;

thus they become stiffly connected, and when the work is finished, and the bond cut from the openings, it will leave the iron bond in the brickwork attached to a wood brick on each side of the opening as in the margin.

In Plate 8 is the plan, elevation, and section of a wing retaining or wharf wall, to support

any heavy pressure from behind. The various sets-off at the back form counterforts, which, by the downright pressure of the superincumbent earth upon them, overcome, in a great degree, the great lateral pressure; even in raising a nine inch wall some two feet or more for footway curbs, course of headers in the back, projecting half brick from the work, will take off much of the lateral pressure thus:—



The pockets of all chimney-breasts at the set-off of the flues should be filled in solid and grouted, and care taken that the internal sides of the flues be carefully pargetted and finished very smooth; the parge is made by mixing soft cow-dung with mortar to a proper consistence, and forms, when dry, a very tough cement; in finishing the tops of chimneys, the upper courses should be laid in cement closely jointed.

BRICKWORK

USEFUL MEMORANDA.

272 Feet superficial, 1 rod of brickwork at $1\frac{1}{2}$ brick or $13\frac{1}{2}$ inches thick, which is considered the standard thickness, and to which all brickwork is reduced.

306 Cube feet, 1 rod of reduced brickwork, being the cube quantity produced by multiplying 272 feet by $13\frac{1}{2}$ inches, or $1\frac{1}{2}$ brick, the standard thickness of all brickwork.

4500 Bricks, allowing for waste, will build 1 rod of reduced brickwork.

18 Bricks to each reduced foot of brickwork.

A rod of brickwork contains $11\frac{9}{27}$ cube yards, or eleven cube yards and nine cube feet.

8 Bricks to 1 foot superficial of marl facing laid Flemish bond.

10 Bricks to 1 foot superficial of guaged arches.

To reduce cube feet of brickwork to the standard thickness of $1\frac{1}{2}$ brick, multiply by 8, and divide by 9, the standard thickness of $1\frac{1}{2}$ brick, or $13\frac{1}{2}$ inches, being $\frac{9}{8}$ of a foot.

A stock brick is $8\frac{3}{4}$ inches long, $4\frac{1}{4}$ inches wide, and $2\frac{3}{4}$ inches thick; each brick weighs about 4 lb. 15 oz.

384 Bricks to one cubic yard.

$14\frac{1}{2}$ Bricks to one cubic foot.

1 Ft. of brickwork laid close weighs about 1 cwt.

1 Rod of brickwork weighs about thirteen tons.

52 Stock bricks laid edgeways will pave one superficial yard.

32 Ditto laid flat will pave a yard supl.

14 Ten inch tiles will pave one yard supl.

10 Foot tiles will pave one yard supl.

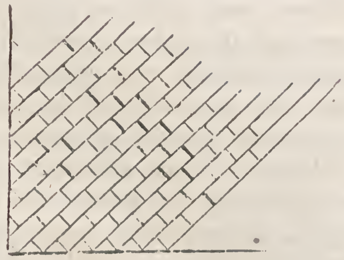
72 Paving bricks laid on edge will pave one yard supl.

32 Ditto laid flat will pave one yard supl.

The paving brick is 9 inches long, $4\frac{1}{2}$ in. wide, and $1\frac{3}{4}$ in. thick

10 In. tile is $9^1/_2$ inches square and $1^1/_2$ in. thick.
12 In. ditto is $11^1/_2$ inches square and $1^1/_2$ in. thick.

Brick paving is very often laid diagonally, and is called herring-bone paving (see diagram).



DESIGN FOR A PAIR OF SEVEN ROOMED HOUSES.

See Plate 10.

This design comprises, on the Basement, a Breakfast Parlor, Kitchen, Pantry, and Coal Cellar; on the Ground Floor, two Parlors and Store Closet; and on the Chamber Plan, three Bed Rooms and W. C. The dimensions of the rooms are figured and their arrangement is compact and convenient. To the Elevation a moderate and inexpensive amount of decoration has been given, and it is proposed to be faced with Kentish red bricks, with cement dressings to the doors and windows. The height of the Basement is 8′ „ 6″; that of the Ground Floor 10′ „ 3″, and the Chamber Floor 9′ „ 0″. The roof is covered with Italian formed zinc. Erected thus, with the internal fittings of a plain, substantial character, the cost will be for the pair £ 700.

MORTARS, &c.

By mortar, is meant a mixture of lime and sharp sand, mixed with water to a proper consistence, and thoroughly beaten up, chafed, or pounded, so as to be completely and intimately amalgamated together. The component parts being usually three or $3^1/_2$ cube yards of good sharp sand, to one cube yard of grey stone lime; or two yards or $2^1/_2$ yards of sand to one of chalk lime; sharp road scrapings is used in great quantities instead of sand, and where it is taken from roads that are kept in order with flint, or gravel, forms a very good mortar; but it should lie heaped up in quantities for a considerable time before use, to allow for the decay of any animal or vegetable matter that it may contain. In describing the various kinds of lime and mortar, the introductions of a most clever extract from a work upon hydraulic and common mortars, by General Treussart, taken from the "Civil Engineer and Architects' Journal," is here given in full: —

"Lime has been employed time immemorial; mixed with sand or certain other substances, it forms mortar. Although the solidity and durability of masonry depends on the goodness of mortar, still few experiments have been made with lime; and the manner of making mortar has almost always been given up to the workman. It is only within about 50 years that a few scientific men have attended to this important subject. Comparing the mortars of the Ancients, and especially of the Romans, with those of modern times, it was perceived that the old mortars were better than ours, and the means have consequently been sought of imitating them. Several constructors have thought they had discovered the secret of making Roman mortars; others, on the contrary, have thought that the Romans had no particular process, but that of all their constructions those only that were made of good lime had survived to our day. We shall see that my experiments tend to confirm this latter opinion.

"Lime used in buildings is obtained by the calcination of calcareous stones, which occur abundantly on the surface of the globe. Marble, certain building stones, chalks, calcareous

alabaster, and shells are employed in making lime. The effect of calcination is to drive off the water and the carbonic acid which are combined with the lime. The water and the first portions of carbonic acid pass off easily, but it requires an intense and long-continued heat to dispel the remainder of the acid. Lime, as used in constructions, contains almost always a considerable quantity of carbonic acid.

"When the stone submitted to calcination is white marble, pure lime is obtained, provided the calcination be carried far enough. According to an analysis which I made of white marble, this substance contained in 100 parts as follows: lime, 64; carbonic acid, 33; water, 3. Lime obtained by calcination possesses the following properties; it has great avidity for water, imbibes it from air, and has its bulk enlarged thereby. If a certain quantity of water be thrown on lime recently calcined, it heats highly, breaks with a noise, and a part of the water is evaporated by the heat produced. The disengaged vapour carries off some particles of lime. Water dissolves about one four-hundredth of its weight of lime, forming what is called lime-water. Lime is a caustic, and turns the syrup of violets green; its specific gravity, according to Kirwan, is 2.3; it attracts carbonic acid from the air, and finally returns to the state of carbonate of lime. To preserve it, it is necessary to keep it in very tight vessels.

"Lime was formerly ranked among the alkalis, and it is only lately that its true nature was known. Davy, the English chemist, in 1807, succeeded in decomposing, by means of Volta's pile, the sulphate and the carbonate of lime, or more properly, lime derived from these substances, obtaining a brilliant substance having so strong an attraction for oxygen, that it immediately absorbs it from air and from water, which it decomposes; the brilliant substance derived from lime is regarded as a metal, and has received the name of calcium. Accordingly, lime is only a metallic oxyde. It is rarely that lime derived from white marble is used in the arts; that which is commonly used, and which is derived from ordinary limestone, almost always contains oxyde of iron, and sometimes a certain quantity of sand, alumine, magnesia, oxyde of manganese, etc. Some of these substances combine with the lime by calcination, and the lime thus acquires properties which it had not before, and of which I shall speak in the sequel.

"If we take lime derived from white marble, or from common limestone, and reduce it as it comes from the kiln to a paste with water, and if we place this paste in water or in humid earth, it will remain soft for ever. The same result will be obtained if lime be mixed with sand and the resulting mortar be placed in a similar situation.

"It is a common practice to deluge lime fresh from the kiln with water, and run it into basins where it is allowed to remain in the condition of soft paste. Alberte says he has seen lime in an old ditch that had been abandoned about 500 years, as was conjectured by very manifest indications, which was still so moist, well tempered, and ripe, that no honey or the marrow of animals could be more so.

"There is another kind of lime, which possesses a singular property: if it be slaked as it comes from the kiln, as above, and then placed in the state of paste in water or in moist earth, it will harden more or less promptly according to the substance it contains. The same result is obtained if the lime, being mixed with sand, is made into mortar and placed in a similar situation. If the lime be slaked and run into vats, as is done with common lime, it will become hard after a little time, and it will be impossible to make use of it.

"On slaking lime fresh from the kiln with enough water to reduce it to paste, it is found to augment considerably in bulk; this augmentation is such that one volume of quick lime will sometimes yield more than three volumes, measured in the condition of thick paste. When the lime which has the property of hardening in water is slaked in the same manner, it affords a much smaller volume than common lime. Sometimes one volume of this lime measured when slaking will give, when slaked to a thick paste, scarcely an equal bulk. For a long time these limes which had the property of hardening in water were called meagre

limes, and those which had not this property were called fat limes. These denominations were given, because the first increased but little in bulk when made into paste, while the other gave a considerable augmentation of volume, and because fat limes formed, with the same quantity of sand, a much fatter or more unctuous mortar than meagre lime. But the denomination, meagre lime, is altogether improper to indicate limes which enjoy the property of hardening in water, because there are limes which augment their volume very little on being made into paste, and at the same time possess no hydraulic property. Belidor gave the name of 'beton' to lime which had the quality of hardening in water; but many engineers continued to call it meagre lime. The denomination of beton is not suitable, and in this sense is not now in use. The following are the terms now employed:—

"In England the name of aquatic lime has been given to the lime which indurates in water; in Germany it is called lime for the water. M. Vicat, engineer of roads and bridges, has proposed the name of hydraulic lime; and this denomination, which is a very good one, has been generally adopted. I shall therefore call that lime which swells considerably in slaking, 'fat lime;' that which swells but little and does not harden in water, 'meagre lime;' and that which has the property of hardening in water, 'hydrâulic lime.' Fat lime is often 'common lime;' also the term 'quick lime' is applied to all unslaked limes, whether fat lime, meagre lime, or hydraulic lime. Although meagre lime and hydraulic lime may have been calcined exactly to the proper degree, still they are slower to slake and give out a less degree of heat than fat lime. When fat lime has been too much burned it becomes slow to slake, while, if properly burned, it begins to slake the instant water is thrown upon it. Experiments, to be given in the sequel, will show that iron in the state of red oxyde causes fat lime to slake slowly.

"Some of the ablest chemists have at different times sought to detect the substance which imparts to lime the property of indurating under water.

"Bergman, a Swedish chemist, was, I think, the first who gave an analysis of an hydraulic limestone. That from Lena in Sweden he found to contain in 100 parts the following substances: lime 90, oxyde of manganese 6, clay 4. Bergman seems to have attributed the peculiar property of hydraulic lime to the oxyde of manganese, and this opinion prevailed for a long time; on the other hand, we find in the 'Bibliothèque Britannique' of 1776, vol. iii, page 202, that Smeaton, the English engineer, who built the Eddystone Lighthouse in 1757, attributed this property to clay; for, he says, it is a curious question, which he will leave chemists and philosophers to decide, why the presence of clay in the tissue of calcareous stone should give it the property of hardening in water, while clay added to common lime produces no such effect?

"Guyton de Morveau announced, in a memoir published in 1809, that he had detected the presence of oxyde of manganese in all the limestones afforded by hydraulic limes; he announced further, that in calcining together 90 parts of common limestone pulverized, 4 parts of clay, and 6 parts of black oxyde of manganese, an excellent artificial meagre lime would be obtained. It was stated above, that at that time the name meagre lime was given to lime that would set under water; the French chemist was the first, therefore, to make artificial hydraulic lime; but he, as well as Bergman, was mistaken in supposing that the presence of the oxyde of manganese was necessary to the result. He would have obtained his result by burning the pulverized limestone with clay alone.

"M. Saussure says, the property possessed by certain limes of hardening in water is due solely to silex and alumine, that is to say, clay combined in certain proportions.

"M. Vitalis, chemist of Rouen, made, in 1807, the analysis of the limestones of Senonches and St. Catherines near Rouen: the analysis is contained in the memoir on the Schists of Cherbourg, published, in 1807, by M. Gratien, senior engineer of roads and bridges. This limestone contains, according to M. Vitalis, in 100 parts, the following substances: water 12,

carbonnate of lime 68, alumine 12, sand 6, oxyde of iron 2. In addressing these results to M. Gratien senior, M. Vitalis expresses himself thus: 'It follows from the analysis that the limestones of Senonches and St. Catherines are two calcareous marles, in which the chalk predominates, it is true, but wherein the clay performs an important part. It is this portion of clay which, in my opinion, makes the lime in these two limestones meagre; whence it follows, that the presence of oxyde of manganese is not indispensable to the constitution of such limes, since the analysis proves that the limestone in question contains no oxyde of manganese, as it would, if present, have colored the glass violet.' I noticed above that these hydraulic limes were then meagre limes. We see that the analysis of these stones confirms the opinion of M. Saussure, who had attributed to the clay alone the power of hardening in water. Thomson, an English chemist, is of the same opinion.

"M. Descotils, engineer of mines, also made an analysis of the limestone of Senonches, which analysis may be found in the 'Journal des Mines' of 1813, page 308. According to this trial the Senonches limestone contains a quarter part of silex disseminated in very small particles, and only so small a quantity of iron and alumine that these subjects can have no influence on the lime; whence this engineer concludes that the hydraulic property of this limestone is owing to the silex. We have, however, seen above, that, according to M. Vitalis, it contains twice as much alumine as silex. M. Berthier also inserted in the 'Journal des Mines' an analysis of the Sinonches limestone, which will be given further on, and according to which the stone contains very little alumine. This contradiction has not yet been explained. Perhaps the quarries at that place afford stones of different kinds. If so, it would be important to ascertain what is the composition of the best.

"The analysis of the Senonches limestone afforded M. Descotils occasion to make an important remark on the silex contained in limestones, viz. that the silex found in these stones does not dissolve in acid before calcination, but does dissolve after calcination. This fact proves that the properties of silex are changed by calcination with lime, and that it combines in a dry way with this substance.

"M. Vicat, engineer of roads and bridges, published, in 1818, a very important memoir on hydraulic mortars. This engineer sets out with the opinion generally entertained at that time, that it was the clay that gave to lime the singular property of hardening in water. He, in consequence, took fat lime, which he mixed with various proportions of clay, according to the following process:—'The operation, we are about to describe,' says M. Vicat, 'is a true synthesis, reuniting in an intimate manner, by the action of fire, the essential principles which are separated from hydraulic lime by analysis. It consists in allowing the lime which is to be improved to fall spontaneously to powder in a dry covered place; afterwards to mix it, by the help of a little water, with a certain quantity of grey or brown clay, or simply with brick earth, and to make balls of this clay, which, after drying, are to be burned to a proper degree.'

"Being master of the proportions, we may conceive that the factitious lime may receive any degree of energy required, equal to, or surpassing at pleasure, the best natural lime.

"Very fat common lime will bear 0.20 of clay to 1.00 of lime; moderately fat lime will have enough clay with 0.15; and 0.10, or even 0.06 of clay will suffice for these limes, which are already somewhat hydraulic. When the proportion is forced to 0.33, or 0 . 40, the lime does not slake; but it pulverizes easily, and gives when tempered a paste which hardens under water very promptly.

"Such is the process indicated by M. Vicat. But this engineer did not content himself with experiments on a small scale; a manufactory was established near Paris by his means, where artificial hxdraulic lime is made in large quantities; he moreover exerted himself to extend the use of hydraulic mortar everywhere, and he succeeded. He has, therefore, rendered

an important service to the art of construction; and I have done him the justice to make this acknowledgement in the notice I have heretofore published.

"In 1818, Dr. John, of Berlin, presented to the society of Sciences, in Holland, a memoir which was published in 1819. In this memoir the following questions proposed by the Society were answered — What is the chemical cause, in virtue whereof stone lime generally makes more solid and durable masonry than shell lime, and what are the means of improving shell lime in this respect? Dr. John remarked that shells require to be more highly calcined than common limestone; he thought this owing to the shells being purer carbonate of lime than common limestone, which contains earthy substances, facilitating the disengaging of the carbonic acid. In making the analysis of sundry limestones, he found that those which afforded hydraulic lime contained clay, oxyde of iron, etc. He called the foreign matters, which gave the property of hardening in water, cements, and said, that it is possible, by introducing cement in the dry state, to ameliorate lime which contains none. On these considerations he made the following experiments: — He mixed the powder of oyster shells first with $^1/_{16}$ of silicious sand; secondly with several proportions of clay, varying from $^1/_{10}$ to $^1/_3$; thirdly, with $^1/_{40}$ of oxyde of manganese. He tempered these mixtures with water, formed them into balls, let them dry in the air, and then burned them in a lime kiln for 96 hours. The following results were obtained: the first mixture was agglutinated, but friable, and had not a good result; the second mixture gave a good result; and the third possessed no peculiar property. The author concludes that clay is the ingredient which gives to lime the property of hardening in water; and he says that nothing can be easier than to procure good hydraulic lime, either from shells or from pure limestone; following the process indicated, he adds, that it is for constructors to determine the best mixture to be made in each case.

"The memoir of Dr. Johnson contains an analysis of several ancient mortars, and offers several important observations, of which I shall have occassion to speak. In the third number of the 'Annales des Mines' of 1822, there is a very interesting memoir by M. Berthier, Ingénieur en chef des Mines; it contains the analysis of different limestones, and several new views, which will contribute to form a more perfect theory of mortars. I shall have more than one occasion to cite his experience and opinion on several important facts.

"M. Raucourt, engineer of roads and bridges, published at St. Petersburg, in 1822, a work, wherein he narrates the experiments be made. Following the process of M. Vicat, and adding several of his own, M. Bergère, Chef du Bataillon du Génie, gave an analysis of this work in the 'Annales des Mines' of 1824, Vol. 9.

In 1825 M. Hassenfratz published a memoir on mortars. This works, which is voluminous, contains many practical details on the calcination of limestone in different countries, and exhibits the actual state of knowledge in the art of making mortars, at the period of its publication.

In terminating this reference to works on hydraulic mortars which have appeared up to this time, I must introduce a fact but little known, announced by M. Girard de Caudenberg, Engineer of roads and bridges, in a notice published by him in 1829. He states that the proprietors of mills on the river Isle, in the department of the Gironde, discovered by accident a kind of fossil sand to which they gave the name of *arène*, which has the singular property of hardening under water without any preparation, and has great durability. I shall have occasion to return to this important fact and to report what M. Girard says, as well as to state the principal experiments which have been made with this substance in other places where it has been found. "I was employed, from 1816 to 1825, at Strasburg, at which place no use of hydraulic lime had been made: I ascertained however that such lime was to be found in the neighbourhood. Almost all the hydraulic works, connected with the fortifications of the place, having been badly constructed, and dating as far back as Vauban's time, were to be rebuilt. Twenty-five years experience had taught me the geat superiority of hydraulic mortars in the air as well as in the water, where indeed

they are indispensable. I tried therefore the hydraulic lime afforded by the environs of Strasburg, and found it excellent for mortar; it was consequently used in all the works both in air and water. All the revêtements, built from Porte de Pierre to Port Royal, having a development of about 1,650 yards, were rebuilt or repaired with this hydraulic mortar. It was the same with the hydraulic works. They were rebuilt or repaired with the hydraulic mortar of the neighbourhood."

An engineer who should use rich (fat) lime for building, even in the air, when there are hydraulic limes at hand, would be very censurable; because the expense is about the same, and as regards the strength and durability of the masonry, there is a vast difference in favor of the hydraulic mortar. But in countries where no hydraulic lime is to be had, or only that of indifferent quality, what is to be done? Shall the engineer adopt the process of M. Vicat, in making artificial hydraulic lime? I answer emphatically that I think not; it is in my opinion preferable to make hydraulic mortar by a more direct process, which I shall point out.

There are two modes of obtaining hydraulic mortar; the first consists in mixing natural or artificial hydraulic lime with sand; the second consists in mixing ordinary rich (fat) lime with certain substances, such as puzzolana, trass, coal ashes, and brick or tile dust. I feel bound to correct here an assertion by M. Gauthey, Inspector of roads and bridges, touching these mortars which is not perfectly accurate. In his excellent treatise on the construction of Bridges, this engineer says vol. 11, page 287, that rich lime is very proper for constructions out of water, but will not answer in water, because the mortars in which it is used, even when mixed with puzzolana and placed in water as soon as made, do not harden, but remain pulverulent. This is far from exact, because mortar, composed of rich lime and puzzolana, hardens very soon in water, and acquires in a short time very great strength. This fact was known to the Ancients, for it is spoken of by Vitruvius.

HYDRAULIC MORTARS.

No. 1.

Smeaton's mortar, as used for the Eddystone lighthouse, was composed of equal parts of Aberthaw lime in the state of hydrate of lime in fine powder, and puzzolana also in fine powder, well beaten in mullars, until it had acquired the utmost degree of toughness.

No. 2.

Another hydraulic mortar is composed of $2^1/_2$ parts of burnt clay, 1 part of blue lias lime, to be pulverized and ground up together between rollers and immediately used.

No. 3.

Or it may be formed of two bushels of fresh stone lime, three bushels of wood ashes, mixed the same as lime and sand, but allowed to remain until cold, and beaten thoroughly three or four times before using.

No. 4.

4 parts of blue lias lime, 6 parts of river sand, 1 part of puzzolana, 1 part of calcined iron stone.

This cement was used for setting the outside facing of the brick walls of the London Docks.

WATER-PROOF MASTIC CEMENT.

No. 1.

50 parts of sharp sand, 50 parts of stone lime ground, 10 parts of red lead in powder to be mixed with boiled oil.

No. 2.

100 parts of sharp sand, 50 parts of whiting in powder, 10 parts of red lead ditto, mixed with boiled oil.

No. 3.

100 parts of sharp sand, 25 parts of plaster of Paris, 10 parts of red lead, 5 parts of yellow ochre, all in powder and mixed with boiled oil.

MORTAR.

No. 1.

1 cubic yard of Dorking or grey stone lime, 3 to $3^1/_2$ yards of sharp river sand.

No. 2.

1 cubic yard of stone lime, 4 cubic yards of coarse gravelly sand.

No. 3.

1 cubic yard of stone lime, 4 cubic yards of coarse gravelly sand, which contains oxyde of iron.

No. 4.

1 part of lime, 2 parts of sharp sand, 1 part of blacksmith's ashes—black oxide of iron.

No. 5.

1 part of lime, 2 parts of sharp sand, 1 part of coarse ground coke.

There are many other compositions of mortar and cement in use, but the before-mentioned have been tested for years. Localities will occasion many variations in the composition of mortars and cements, arising from the various kinds of lime which they contain and the calcareous sand or material compounded with them.

TIMBER.

The timber usually made use of for building in this country comes principally from the Baltic and Canada, with the exception of the red pine: the other sorts of American pine, (for instance the yellow pine,) are not proper building timber, although much of them is used, owing to their being of large scantling, very clean and free from knots, and much cheaper than the Baltic produce. Memel, Dantzic, Reval and many other ports furnish immense quantities of timber, cut deals and planks; as do also the various ports of Sweden. To the Swedish timber, as adapted for small buildings, attention should be particularly drawn. The Memel and other superior timbers are usually imported die square, and parallel; but the Swedish and lower port timber are smaller, only partially squared, and always run taper, being much smaller at the one end than the other; and to arrive at the best method of adaptation of logs of that shape is of consequence. In

purchasing timber the sticks should be chosen, if posible, of such dimensions as to cut without waste in the length. The lengths of joists are easily arrived at, also the height of partitions and lengths of rafters. Supposing joists 24 ft. long, then a stick 24 ft., 25 ft. or 26 ft. will not waste, as the tail pieces, when cut off, come in for wood bricks; beyond that length there will be waste. But if your partitions are 8 ft. high, then take a stick 32 or 33 ft. in length. From experience it is found, that timbers for small buildings cut to advantage at 16, 17, 20, 24, 32 or 33 feet. The greater the length, for buildings of magnitude, the better; but in that case no length ought to be cut from a large stick, until the remaining part of such stick is apportioned, its purpose known, and in what part of the building it is afterwards to be applied. In the adaptation of taper timbers, much waste is occasioned by slicing wedge pieces off to make them parallel, which become useless and cause an expenditure which should not occur. Suppose a Swedish log 25 feet long, $11^1/_2$ in. square at the but, and $10^1/_2$ in. $\times$ $10^1/_2$ in. at the small or taper end: this being the exact length for floor joists, which are to be cut 2 in. by $7^1/_2$ inches deep; strike a line parallel to the straightest side of the piece at $7^1/_2$ inches distance, and separate the log into two flitches, (Plate 12, Fig. 1,) one of which will be 4 in. deep at one end, and 3 inches deep at the other; the other flitch will be $7^1/_2$ in. deep and parallel; turn this piece down and line it for six joists. To divide it equally, lay down a rule in a diagonal manner, so that the one foot reaches across the timber, and mark off every two inches: do the same at the smaller end, and through those mark, line it and saw five cuts; which will separate it into six joists, a little thinner at one end than the other, but barely perceivable; (see Plate 12, Fig. 2.) Now front rooms being always the largest, the stout or strong end should be on the front plate, that is, the strongest end of the joists over the longest bearing, the smaller end over the shortest, so that equal strength may be distributed throughout; take the other flitch, (Plate 12, Fig. 3,) twenty-five feet long, $11^1/_2$ in. $\times$ 4 in. at the larger end, and $10^1/_2$ in. $\times$ 3 in. at the smaller end, cut it into six, and it will make six ceiling joists, of sufficient strength for fourth-rate, or small cottage buildings: scantling of this size and adaptation applies to buildings of not exceeding six to eight rooms. In villas or roomy dwellings the scantlings must be greatly increased. Proceed with another piece of timber of smaller diameter, but of the same length, or one or two feet longer, say $10^3/_4$ in. $\times$ $10^3/_4$ in., at the larger end, and $9^3/_4$ in. $\times$ $9^3/_4$ in. at the smaller end, (Plate 12, Fig. 4.) From the widest side break the stick down at a parallel of $7^1/_2$ inches, it will then form two flitches; one $10^3/_4$ in. $\times$ $7^1/_2$ in. at one end, and $9^3/_4$ in. by $7^1/_2$ in. at the other; divide this into five floor joists as before described. (Plate 12, Fig. 5.) The flitch that is left, (Plate 12, Fig. 6,) will be found to be $10^3/_4$ in. $\times$ $3^1/_4$ in. at one end, and $9^3/_4$ in. $\times$ $2^1/_4$ in. at the other. This should be cut into five pieces and laid by for ceiling joists. Or suppose a stick of timber, (Plate 12, Fig. 7,) 10 in. $\times$ 10 in. at the larger end, and $9^1/_2$ in. $\times$ $8^1/_2$ in. at the smaller. From the straightest side break it down at $7^1/_2$ inches parallel: two flitches will be produced, one 10 in. by $7^1/_2$ in. at the larger end, and $9^1/_2$ in. $\times$ $7^1/_2$ in. at the smaller; which break (by dividing as before) into five joists. The other flitch will be 10 in. by $2^1/_2$ in. at the larger end, and 9 in. by 2 in. at the smaller: take at joist from that at $7^1/_2$ in. parallel, and you will have a stout trimmer joist $2^1/_2$ in. at one end and 2 in. at the other, (Plate 12, Fig. 8); this will do to trim for the well of the stairs. Place the taper piece with the ceiling joists before named.

The following observations may be useful in this place: A long piece of timber shonld never be cut, unless a short piece cannot be found: a piece of scantling with two sawn faces should never be used where one sawn face will suffice; scantling with three sawn faces should not be used where two are sufficient: and all scantling with four sawn faces should be used only where the best framed work is required. The saving of sawing in the adaptation of timber is very great if properly attended to. Again, for the quartering for filling in partitions, in taper timber: suppose a piece sixteen feet long, (Plate 13, Fig. 1,) 14 inches square at one end, and thirteen inches square at the other: strike a chalk line in the very centre of the piece, and set off 4

inches on either side, and saw the log into four flitches: line them in the same way, and each of the two middle pieces will cut into two scantlings 4 in. >< 3 in., (see Plate 13, Fig. 2,) sawn on all four sides, and two irregular pieces sawn on three sides but much stronger. Each of the outside pieces will cut into two scantlings, 4 inches by the average thickness of the slab, sawn on three sides, and two irregular pieces of greater strength sawn on two sides, (see Plate 13, Fig. 3.) In crooked timber, if the break be not much, and it is to be cut for joists, a break may be made in the sawing, (see Plate 13, Fig. 4,) so that the bend of the break be near to the partition head, upon which the joists rest: and for the framed parts of partitions, all the square and sawn scantling from the middle of the logs should be preserved. In dividing a log for partition stuff, care should be taken to divide it so, that the two outside quarters have thickness sufficient, however irregular, to be useful for filling in the quarters of partitions. Again, in taper timbers, let the outside flitches, if $4^1/_2$ in. at one end and $3^1/_2$ in. at the other, or if 5 in. at one end and $3^3/_4$ in. at the other, (Plate 13, Fig. 5,) be divided diagonally at each end, as before described, and cut into rafters; these will be the better for being stouter at the foot, and not one particle of the timber lost. By strict attention to lining out timbers before sawing a great saving is to be effected. The following novel rules for calculating the quantity and price of scantling will not be out of place here: they are founded upon and calculated at the presumed price of four pounds ten shillings per load of fifty feet of timber. Therefore, whatever be the price of the timber per load, prime cost, for every $5^0/_0$ per load above, or below £ 4 „ 10 „ 0, add or subtract, as the case may be, five per cent to or from the amount of pounds that the quantity may amount to.

The value of a load of timber, when converted into scantling, may be estimated to be nearly as follows.

Timber, prime cost per load	£ 4 „ 10 „ 0
Cartage	5 „ 0
Sawing	15 „ 0
Waste one-sixth	15 „ 0
	£ 6 „ 5 „ 0
20 per cent profit . . .	1 „ 5 „ 0
	£ 7 „ 10 „ 0

To find the value of any given quantity of scantling at the above rate of charges and cost, the following is the rule:

Find the area of the transverse section of the scantling in square inches, and for every square inch charge one farthing. Multiply the number of feet in the length of the scantling, by the number of pence contained in the farthings, and it will be the value of the scantling in pence, which reduce.

Example 1. To find the price of 600 ft. of fir 4″ >< 3″.
Area of scantling 4″ >< 3″ = 12 square inches.
12 square inches equal to 12 farthings = to threepence.

600 ft.
3 *d.*
12 | 1800
2,0 | 15,0
£ 7 „ 10 „ 0. Value of the 600 ft.

To find the number of cubic feet, contained in a given quantity of scantling, divide the value of the scantling in shillings by three, thus:

The value of 600 ft. of fir, 4″ × 3″ being 150 shillings:

Example 2.

3 | 150 shillings
50 cube feet or one load.

Example 3. 60,000 ft. of fir 4″ × 2″ = 8 inches = 8 farthings = 2*d.*

60,000
2
12 | 120,000
10 | 10,00,0
Value 500 £

3 | 10,000 shillings.
50 | 3,333 1/3 cubic feet
66,33 1/3
66 loads 33 1/3 cub. ft.

Proof: 66 loads at £ 7 *s* 10.
7
462
10*s* „ half 33
4 „ 19 „ 0 the price of 33 ft. at 3s.
1 „ 0 ditto of one-third of a foot.
£ 500 „ 0 „ 0

Example 4. The price of timber in the

Yard taken at . . .	£ 3 „ 10 „ 0 per load.
Cartage	5 „ 0
Sawing	15 „ 0
Waste one-sixth . . .	11 „ 8
	£ 5 „ 1 „ 8
20 per cent profit . . .	1 „ 0 „ 4
	£ 6 „ 2 „ 0 per load.

Nine hundred feet of fir 4″ × 2″

4″ × 2″ = 8 inches = 8 farthings = 2*d.*

900
2
12 | 1800
20 | 15,0
£ 7 „ 10 „ 0

3 | 150 shillings
50 cubic ft.

deduct four times
5 per cent upon pounds } 1 „ 8 „ 0

Value £ 6 „ 2 „ 0 per load.

Example 5.

Timber per load . .	£ 5 „ 0 „ 0
Cartage	5 „ 0
Sawing . . .	15 „ 0
Waste one-sixth . .	16 „ 8
	£ 6 „ 16 „ 8
20 per cent profit	1 „ 7 „ 4
	£ 8 „ 4 „ 0

900 ft. fir 4" $\times$ 2" = 8 inches = 8 farthing = 2*d.*

$$\begin{array}{r} 2 \\ \hline 12 \mid 1800 \\ \hline 20 \mid 15,0 \\ \hline \pounds\ 7\ ,,\ 10\ ,,\ 0 \end{array}$$

add twice 6 per cent on pounds 14 ,, 0

£ 8 ,, 4 ,, 0

CARPENTER'S WORK.

In fixing quarter partitions, they never should rest or bear upon the floor joists, because when the joists shrink, which is invariably the case, the partition that stands upon them will give way, and a crack will appear in the plaster cornice, which, however small, is very unsightly and cannot easily be repaired, because, the line being broken, a break or jamb will be formed which will readily be detected; to avoid this, place upright puncheons between or by the side of every joist, standing on the top plate or lower partition head, for the bottom plate of the upper partition to stand upon. In this case, when the joists shrink, a small opening is left between the bottom edge of the skirting and the floor, leaving the partition plaster and cornice uninjured, (see Plate 14, Fig. 1.) Wherever folding doors are introduced, the upper part of the partition must be trussed, (see Plate 14, Fig. 2), and, where much weight is to be carried, the strength of the truss should be much increased by the addition of four half-inch iron screw bolts, introduced as shewn in the plan. The floor joists should be carefully strutted with small scantling, say 2" by $1^1/_2$", or any small ends of stuff about that size, and cross-braced or herring-bone strutted in rows not more than four feet asunder, or two rows to a common sized room, (see Plate 14, Fig. 3.) Should the outside joist not be close to the wall, a block should be placed between the side of the joists and the wall, to form an abutment. Plate 14, Fig. 4, is the plan of a naked framed floor, shewing the method of trimming for the chimney breasts, and for the well of the stairs. *A*, trimming joist, $7^1/_2$" $\times$ $2^1/_2$". *B*, trimmer and the bridging joists $5^1/_2$" $\times$ 2". Plate 14, Fig. 5, shews the method of notching the joists down upon the plates, and care should be taken to level the plates properly upon the walls, both ways, that they may be perfectly out of winding with each other, before bedding them; so that any little deviation from the level may be adjusted by proportioning the thickness of the mortar bed. When notched down, and tried by a straight edge to ascertain that the joists exactly range on their top edges, they should be securely nailed down to the plate. Plate 14, Fig. 6 and 7 shews the proper method of cutting the tenon and lap, at the end of the trimmers passing through the trimming joists and secured by a wedge pin: the short trimmers should be cut in the same way, but merely go through; or a small mortice and ship lap may be used for the short trimmers or filling in joists, (see Fig. 8 and 9, Plate 14.) Wherever a gutter plate is used, it should be framed of two flitches 10" by $2^1/_2$", and the gutter laid within it, (see Plate 15, Fig. 1.) The two sides should be framed together with short puncheons, about 2 ft. apart, leaving a space of nine inches between them for the gutter boards, and framed to secure a proper drip and good fall. Every other puncheon should have a long tenon, (Plate 15, Fig. 2,) morticed through, and pin wedged the same as for the trimmers of floors. When the gutter is fixed, it should be kept up one quarter of an inch in the middle on the partition head. The

rafters should be cut with a Bird's mouth, and the heel of each notched into the side of the gutter plate, (see Plate 15, Fig. 3.) A fillet should be well nailed on each side of the gutter plate to notch the ceiling joists to, should they run that way; but as the gutter plate generally runs from front to back, the ceiling joists, particularly if they are cut from the floor joists, will lay the same way as the gutter, in which case the fillets will not be required. In small roofs no other framing may be necessary; but should the rafters extend to nine or ten feet in length, a purlin should be fixed about the middle of them, supported by struts from the set off or a corbel cut into the wall. Where there is more than one floor, or where there are in any building upper rooms and a staircase, a trap door should be left in the roof, at the most convenient place in the ceiling of one of the bed rooms, but never over the staircase: it should be so arranged as to open without the least difficulty, and the step ladder to reach it should always be there. The framing of principals for roofs of any extent requires great care and attention in the setting out of the work, so that every junction in the framing should fit and butt together perfectly square and close in every part; no precaution should be spared to secure so important a consideration. There are many ways of trussing the tie beams and principals for roofs, depending upon the size of the building, and the distance that the walls or supports are from one another; where height of ceiling is required and the bearing points not too distant, a collar truss, (see Plate 15, Fig. 4,) may be used, but it is not to be recommended, because there is a tendency to give where the collar bites the rafter at the dovetail, which should not cut into the side of the rafter more than one half-inch. The collars in scantling should be 9 inches by 2; the rafters 6 in. by 3 in. at the foot, and $4^1/_2$ in. by 3 in. at the top: the ridge board 7 in. by 2 in.; purlins 8″ × 4″, plates 4″ × 3″. In a roof, framed in this manner to obtain height, the principal rafters should not be more than 4 ft. 10 in. apart, or the space of four common rafters at 12 inches distance: the common rafters being $4^1/_2$ in. by $2^1/_2$ in., all resting upon the wall plates. The tops of the principals should be framed open to receive the ridge, but secured together by a strong elm cleet, and the middle of the collar strengthened by suspending pieces, (see Plate 15, Fig. 5,) 4″ × $1^1/_2$″, clipping it on each side and pinned securely there, the flat side at the other end to be nailed to the ridge.

DESCRIPTION.

A, Collar beam. *B, B*, Rafters. *C, C*, Purlins. *D*, Suspending pieces. *E*, Ridge board. *F*, Elm cleet. *G, G*, Wall plates. *H, H*, Iron straps twisted at the bend so as to lie flat and bolted to the rafter foot and the collar.

Plate 15, Fig. 6, is the drawing of a king post truss, and pair of principal rafters, for a roof of forty feet span in the clear. The scantling of the beam should be 14 in. × 7 in., the king post, 14 in. × 7 in. and the top and bottom, and 8 in. × 7 in. in the centre, the principal rafters 8 in. × 7 in. at the foot, and 7 in. × 7 in. at the top, the purlins 6 in. × 6 in., the braces 7 in. × 6 in. the wall plates 4 in. × 4 in., the pole plates 4 in. × 4 in., the ridge boards 7 in. × 2 in. the common rafters $4^1/_2$ in. × 3 in. Should hips be required to the roof, their scantling will require 10 in. by $2^1/_2$ in. The centre of the beam should be properly secured to the king post, the rafter feet to the beam, and the heads of the rafters to the king post, by iron bands and plates. (See Plate 5, Figs. 1, 2, 3, 4.)

DESCRIPTION.

A, Tie beam. *B*, King post. *C, C*, Braces. *D, D*, Principal rafters. *E, E*, Purlins. *F, F*, Common rafters. *G*, Ridge piece. *H*, Pole plate. *I*, Wall plate.

Fig. 7, Plate 15, is the drawing for a queen post truss, and is often used in large roofs to obtain room. In this roof the upper part is intended for a lead flat, and the space between

the queen posts permits the construction of a bedroom 13 ft. 6 in. square and seven feet in height, it is intended for a building with a clear span of forty feet within the walls; the principal rafters abutting against the heads of the queen posts, which are supported by the collar beam, overcome all tendency of the tie beam to deflect; the binders from principal to principal must be the same scantling as the collar beam. The scantling should be as follows: tie beam 14 in. by 6 in., queen posts 12 in. by 6 in.; braces 6 in. >< 6 in.; principal rafters 8 in. >< 6 in. at the foot, and 7 in. >< 6 in. at the head; collar beam 12 in. >< 6 in.; binders from principal to principal 12 in. >< 6 in.; purlins 6 in. >< 6 in.; common rafters $4^1/_2$ in. >< 3 in.; the pole plates 4 in. >< 4 in.; the wall plates 4 in. >< in.; the joists to receive boarding for lead flat 8 in. by $1^3/_4$ in.; the whole of the intersecting parts of the framing to be secured with iron work, as before described.

DESCRIPTION.

A Tie beam. *B B* Queen posts. *C C* Braces. *D D* Principal rafters. *E E* Purlins. *F F* Common rafters. *G* Collar beam. *H* Joists. *I* Pole plate. *K* Wall plate.

LABOURERS' COTTAGES.

It frequently occurs that a slip of land abutting for some distance on the side of a road may be made available for the erection of labourers' cottages: many such slips of an irregular form are to be found in the country: suppose one of considerable length, say 300 feet, and only one rod or $16^1/_2$ feet wide, and that two comfortable and convenient four-roomed labourer's cottages are to be erected thereon. For the method in which it is proposed to obtain convenient space, see plate 20. Fig. 1 represents the elevation carried up in brick, with the quoins and the reveals of the windows and doorways faced with irregularly coursed stone; the eaves and the roof project over the front wall and are finished with a verge or barge-board. The elevation is drawn with solid casement frames and casements; but sashes and frames may be substituted if desired; the washhouse and closet are thrown back; the front door opens into a small passage, (see plate 20 fig. 2 *): the stairs are behind the front door: and on the left is the entrance to the living room, which is 15 feet by 12 ft. and 8 ft. high: immediately in front is the entrance to the kitchen by a descent of two steps, which is 10 ft. by 10 ft. and 8 ft. high, with fireplace and window looking down the whole length of the garden; this opens to a washhouse 10 ft. by 7 ft. with copper immediately behind the chimney, and a pump and sink; beyond the washhouse is the water-closet, the pipe drains from which must be led some distance away; under the stairs is a roomy place for coals or fuel; up-stairs, (see plate 20, fig. 3 *), there is a bed room 15 ft. >< 12 ft., a smaller one 10 ft. >< 10 ft., and space for a closet of good size in the corner by the window of the staircase. Fig. 4, plate 20, shews the transverse section of the building, at *A B* on the plan: and fig. 5, plate 20, the section through the whole of the building, at *C D* on the plan. The estimated cost of the erection of a pair of cottages according to this design is about one hundred and seventy pounds.

DETAILS.

Passage and staircase	10 feet by 5 feet and	15 feet high	=	750 Cub. feet.
Living room . . .	15 feet by 12 feet -	8 feet ditto	=	1440 ditto.
Kitchen	10 feet by 10 feet -	8 feet ditto	=	800 ditto.

* Fig. 2 represents the ground plan of the right hand cottage, and Fig. 3 the bed room floor of the left hand cottage; consequently the arrangement of the rooms is reversed.

Washhouse	10 feet by 7 feet and 7 feet high	= 490	Cub. feet.
Bed room	15 feet by 12 feet - 8 feet ditto	= 1440	ditto.
Ditto	10 feet by 10 feet - 7 feet 4″ ditto	= 733	ditto.

PLAN AND ELEVATION

OF TWO FOURTH-RATE HOUSES, ADAPTED TO FREEHOLD ALLOTMENTS.

In plate 21, will be found the plans, elevation, and section of two fourth-rate houses, of a suitable size and fit for the accomodation of foremen, or managers of factories, mills, or other works, clerks, etc., and suitable for erection either upon two thirty feet, or two twenty-five feet allotments of Freehold Land. Each house contains a small entrance, 4 ft. by 3 ft.; front parlor 14′ „ 6″ >< 12′ „ 0″; back parlor, 11′ „ 0″ >< 9′ „ 0″; passage and stairs, 11′ „ 0″ by 5′ „ 0″; from which a door under the stairs leads to a pantry, 8′ „ 0″ >< 4′ „ 0″; a coal-cellar under the stairs; a kitchen, 10′ „ 0″ >< 7′ „ 6″; a scullery 7′ „ 6″ >< 5′ „ 0″, and water-closet; on the upper floor there are three roomy bed-rooms; viz. a front room 14′ „ 6″ >< 12′ „ 0″ a back room 11′ „ 0″ >< 9 „ 0″, and one over the kitchen, wich is entered from the landing of stairs, 10′ „ 0″ by 7′ „ 6″: a small ornamental window, if necessary, may be introduced in the back wall over the roof of the kitchen to give light to the staircase.

DETAILS

of plans, elevation, and sections of two fourth-rate houses suitable for freehold allotments.

PLATE 21.

				Contents in Cubic feet.
Entrance Hall	4 feet by 3 feet	9 ft.	high. =	108
Staircase and passage . .	11 feet by 5 feet	18 ft.	ditto. =	990
Back parlor	11 feet by 9 feet	9 ft.	ditto. =	891
Front ditto	14′ „ 6″ by 12 feet	9 ft.	ditto. =	1566
Kitchen	10′ „ 0″ by 7′ „ 6″	8 ft.	ditto. =	600
Washhouse	7′ „ 6″ by 5′ „ 0″	8 ft.	ditto. =	300
Water-closet	4′ „ 0″ by 3′ „ 0″	7 ft.	ditto. =	84
Bed room	10′ „ 0″ by 7′ „ 6″	8 ft. 6	ditto. =	637
Ditto	11′ „ 0″ by 9′ „ 0″	8 ft. 6	ditto. =	841
Ditto	14′ „ 6″ by 12′ „ 0″	8 ft. 6	ditto. =	1479

PLATE 21.

Figure 1. Elevation.
- 2. Ground plan.
- 3. Upstairs bedrom plan.
- 4. Section of building at AB on ground plan.
- 5. Plan of roof.

The cost of the erection of one of these houses would be about two hundred and twenty pounds.

FREEHOLD LAND SOCIETIES.

The great increase of Freehold Land societies, and the importance to the community at large of dividing the fee of the freehold land amongst the greatest number of holders, so that, instead of the few, the many may have an interst in the soil of the land of their fathers,

are facts which admit of no dispute. In proportion as the people of this country continue to become separate owners of parts of the soil, will the bond of unity among us be strengthened, and our power to repel the aggressions of foreign foes increased. Every Englishman delights in the land of his birth, and will, in case of need, defend it; but how much is this feeling increased when a portion of the land that he defends is his own—the habitation of the beloved mother of his children and the birth-place of his children themselves! Freehold land societies place it in the power of persons in almost every grade of life, small tradesmen, mechanics, even labourers, to become eventually freeholders. By combining capital they are enabled to purchase land at a cheap rate; and to divide it into allotments each of sufficient size for the erection of a neat cottage, or small house, with land for a garden of sufficient size to secure to the owner his franchise as a freeholder in his native Land, without any dispute as to its annual value. An allotment with a frontage of twenty-five feet, and a depth of one hundred and nine feet, contains ten poles of land, being one-sixteenth part of an acre. In the neighbourhood of almost every large town, and many small ones, a piece of ground of that size and frontage, with good roads made, and the drainage or sewers laid down, will not be worth less than two shillings per foot frontage, or two pounds ten shillings per annum. It is advisable to provide a sufficient guarantee, by covenant in the deed of conveyance, that no continuous rows of houses be erected; none but detached or semi-detached erections should be permitted. By this precaution a pretty and pleasing little village may be formed, no matter what the shape or position of the ground. It should also be a condition to be insisted upon, that no building be erected immediately opposite to another, but that it face the opening between the houses. An allotment of twenty-five feet, supposing two semi-detached houses to be erected on two adjoining allotments will allow a side roadway of good width. The roadway or side entrance of the adjoining allotment having the same space, the opposite house should front this opening between the two erections; by alternating the divisions of the allotments on each side of a road so that the left hand party fence immediately face the centre of the opposite allotment, (see plate 23), this desideratum will be provided for; and it is also desirable, should a single cottage be erected on one allotment, to leave a roadway or space through from the front to the back garden; two allotments adjoining and belonging to the same proprietor will afford room for a good house, and in all cases, at the corners of roads the allotments should be larger, giving opportunities for the erection of buildings for the purpose of trade. Plate 22, gives the plan of eight small closes of meadow-land, proposed to be allotted for a freehold land society; they are bounded on the south-west by a main turnpike road, on the north by a brook, on the east by a back road, and on the south-east by other lands in occupation, the terrier comprises—

	a.	r.	p.
One close of meadow land, plate 22, marked *A* on plan, called the Far Furlong; contents	0 „	2 „	20
One ditto, marked *B* on plan, adjoining to *A*, and called the Middle Furlong; contents	0 „	3 „	6
One close of arable land, marked *C* on plan, adjoining, and called the Home Furlong; contents	2 „	0 „	6
One ditto, marked *D* on the plan, adjoining and called the Long Furlong; contents	2 „	0 „	9
One close of meadow land, marked *E*, in the plan, adjoining, and called the Close Croft; contents	0 „	3 „	8
One ditto, marked *F* on the plan, adjoining to *E*, and called the River Croft; contents	0 „	2 „	30
Carried forward	6 „	3 „	39

	a.	r.	p.
Brought forward	6 „	3 „	39
One ditto, marked *G* in the plan, adjoining to *F*, and called the Low Meadow; contents	0 „	2 „	29
One ditto, marked *H* in the plan, adjoining to *G*, and abutting upon the back road, called the Bridge Meadows; contents	0 „	2 „	15
	8 „	1 „	3

Contents; eight acres, one rood, three poles.

The cost of these eight acres of land may be estimated at £ 185 per acre; and the gross amount, including law expenses, to amount to the sum of fifteen hundred and seventy-five pounds.

A church path runs through the whole length of the estate, by the side of the rivulet; which is to be diverted to the new road, to be called Church-street.

The new road, to be formed and to be called Church-street, is to be 30 ft. wide including footpaths, and its length will be	790 ft.
The second new road to be formed is to be called Queen-street; it is to be thirty feet in width including foot paths, and in length	470 ft.
The third new road to be formed is to be thirty feet wide including footpaths; it is to be called Albert-street, and will be in length	370 ft.
	1630 ft.

The intended new roads and footpaths will therefore be in length 1630 feet, or 543 yards. To form these roads and pathways, with proper crown and drips, the pathways to be ten inches higher than the road, and each pathway five feet in width, leaving the road twenty feet in width; to remove the soil not required, dig out the trenches for drain pipes, and put in drain pipes of glazed stone, with 6 in. junctions to each allotment, and nine inch junctions to the gratings for surface water; cover the road with a coating of chalk or burnt clay, eight inches thick, and over that a layer of flint, gravel, or other hard approved metalling, six inches thick; and cover the footpaths with gravel, three inches thick, will cost, to complete the whole, something under one pound per lineal yard; this amount, viz. five hundred and forty three pounds, added to the amount of the purchase money and law expenses, viz. one thousand five hundred and seventy-five pounds, will make a total of two thousand one hundred and eighteen pounds.

Land and expenses of conveyance, etc., etc.	1575
Roads, drains, etc. etc.	543
	£2118

To meet this outlay the land is proposed to be laid out in the following manner; sixteen allotments, with twenty-eight feet frontage each, and 109 feet deep, fronting the high road: seventy allotments, with twenty-five feet frontage and 109 feet deep each: and eight larger corner allotments, occupying commanding situations for purposes of trade.

	a.	r.	p.
Sixteen allotments, with 28 ft. frontage and a depth of 109 ft. contain . . .	1 „	0 „	19
70 allotments, with 25 feet frontage by an average depth of 109 feet, contain	4 „	1 „	16
8 large allotments contain	1 „	1 „	24
The roads cover a space of	1 „	0 „	20
One half brook, and excess in some allotments	0 „	1 „	4
	8 „	1 „	3

Sixteen allotments, at	£35 each, will produce	. . . .	£ 560
70 ditto at	£30 each. „ „	. . . .	£2100
8 ditto at	£40 each, „ „	. . . .	£ 320
		Total product	£2980
Cost of purchase, laying in drains, and making the roads.		. . . .	2118
			£862

Thus a balance of profit arises, to work out the purposed plan, and to meet and cover all incidental expenses, of the sum of eight hundred and sixty-two pounds, or more than forty per cent.

Plate 16, contains a plan and terrier, for laying out an irregular piece of ground in allotments, for the purposes of a Freehold Land society.

SPECIFICATION FOR FORMATION OF ROADS AND DRAINS.

Specification of works proposed to be done in laying in the pipe sewers and forming and metalling the intended new roads and footpaths to an estate situate at and near to

in the County of

For the Freehold Land Society.

The whole of the closes of land have a gradual fall to the high road and thence to the brook at the bridge, where the back-road crosses it; but with several slight undulations both in the arable and meadow lands. All the roads are to be marked out, and where any cuttings are to be made in the meadow land the turf is to be cut and stripped, in as great lengths as possible and preserved; the soil from the cuttings is to be removed to the parts requiring filling up, properly spread and well rammed.

The construction of the roads is to be everywhere as shewn on the sectional plan: (see plate 22). The corners of the lots at the intersections of the roads are to be rounded off and staked to a radii of 5 feet. In executing the works specified, those centres are to be preserved, and from them the curvatures at the outer edge of the footpaths, at the same corners, are to be described.

Where the roads are to be sunk from the existing surface, the ground is to be excavated to the depth requisite for receiving the thickness of the road materials, where they are to be raised to a height exceeding the thickness of the road materials; the difference is to consist of the earth from the cuttings, laid on and made solid to the range of the formation level. In intermediate situations where the line of the intended finished surface is not as much above the existing surface as the intended thickness of the road materials, the difference is to be excavated in order to make room for them; so that the finished surface shall be everywhere in accordance with the ranging inclination and the sectional line of formation.

All the trees that stand upon the ground, where the roadways have to be formed, are to be grubbed up, and the holes filled in and rammed; all the present hedges that cross, or in any way intersect the lines of road are to be grubbed up, the ditches filled in, and the banks levelled and made solid. The timber grubbed up is to be the property of the contractor.

The whole of the road materials must be laid on everywhere of the uniform thickness specified.

The formation surface is to be made solid and even, and true to the section; and the edges of the footpaths to be trimmed into shape, and rendered as straight as possible.

In forming the embanked portion of the roads, the inferior or subsoil stuff from the cuttings is to be first used, in order that the surplus, if any, shall consist of the vegetable soil.

The future growth of grass through the materials forming the path, is to be prevented by first paring off the turf and the under surface to a depth of four inches, thus removing 6 in. of the original soil below the proposed finished surface.

When the roads are brought, by cutting or embanking, to the formation levels and properly levelled, bench marks are to be placed at convenient distances, to indicate the fall for the drainage; the centre or crown of the road is to be excavated to a proper depth, and nine inch. glazed stone drain pipes, with 6 inch. angle junction, and 6 in. pipes carried to every allotment, of length sufficient to clear the road and footpath; and nine inch. junction pipes with syphon traps, to every grating for surface water, are to be properly laid to a point indicated, within 250 feet of the outlet; from which point the drain is to be continued to the outlet with 12. in. pipes and six in. junctions, and the joints all well stopped with clay.

A self-acting sluice pipe is to be placed at the outlet, protected by brick, wing wall and brick on edge coping built in cement.

Brick cesspools of approved depth, one brick thick, are to be sunk under each grating.

Strong cast-iron gratings are to be placed resting upon the upper courses of the brick cesspools; the last three courses of brick work to be laid in cement.

When the whole of the main pipes are laid, and the collateral junctions to each allotment, the whole of the excavation is to be filled in and well punned; any surplus soil is to be removed, and notice must be given to the surveyor before any of the hard materials are placed thereon.

The banks of the brook and the ditches, where they may be broken and fallen in, are to be thoroughly repaired in the following manner: turf walling, formed with turfs from the unsoiling cut, 1 foot broad, 2 in. thick, and in long lengths from the lines of road, is to be laid evenly and firmly to a proper batter, and filled in solidly behind with earth up to the general height, keeping, as before described, the vegetable mould upwards, and edged with straight turfing at top, with the grass side uppermost.

When the roads are completed to the formation surface and approved by the surveyor, they are to be covered with a layer of chalk, burnt clay, brick-field waste, or other approved core, free from any vegetable or animal matter whatsoever, to a depth of 8 in., and well beaten down and consolidated in accordance with the transverse section.

Over this is to be spread a layer, 6 in. thick, consisting of sifted gravel, or broken granite, or other hard material of the neighbourhood, of approved proportions, every stone capable of being passed through a $2^1/_2$ in. screen; this stratum also is to be beaten or rolled to render it compact.

At the junctions of the new roads with the existing roads, care must be taken to effect a proper gradual union, one with another, of their respective materials, allowing in the new an adequate excess of thickness to allow for their setting to the level of the old.

Upon the formation of the whole length and breadth of the footpaths, a bed of fine gravel hoggen, or other hard approved material, is to be laid and rolled down solid with a heavy roller, leaving a finished thickness of 3 inches of the covering material.

Wherever the finished footpaths are to be lower or higher than the existing surface of the ground of the lots abutting on them, the ground, at the road boundaries of the lots, is to be neatly sloped back from the inner edge of the footpaths, with a uniform batter of $1^1/_2$ to 1.

The whole of the works specified are to be tendered for in two sums; one for the formation and metalling of the roads, and the other for the excavation, drainage, and pipes including brickwork and iron gratings; and the time is to be stated in the latter tender within which the contractor undertakes to complete the whole formation, ready for drainage and metalling from the date of signing the contract.

The gross sum named in the contract is to be understood to include all materials, labor, carriage, cartage, planks, barrows, carts, and every requisite that may be incidental to the complete performance of the works, as set forth in the specification, and the drawings exhibited.

No tender will be entertained, which does not in every respect comply with the requirements specified, and the lowest tender is not to be necessarily accepted.

The contractor, whose tender may be accepted, will be required to give sureties for the due fulfilment of his contract under the penalty of . . . . . . for each day that the works remain unfinished, beyond the time agreed upon for completion.

The contractor is to understand, that he is bound by this contract, to execute and finish, substantially and in a workmanlike manner, of the best materials, and according to the specification, the various works set forth in the specification and drawings exhibited; the whole to be executed in every respect to the satisfaction of the surveyor, without whose certificate no payment will be made.

ASPECT AND PROSPECT.

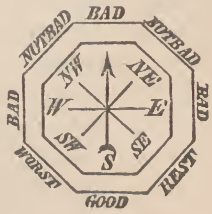
In order to make choice of the best aspect and prospect to be commanded by any building, we have extracted from a valuable work, entitled "Fragments by the late H. and I. Repton," the following excellent remarks: —

"Nothing is more common than for those who intend to build to consult many advisers and collect different plans, from which they suppose it possible to make one perfect whole; but they might as well expect to make an epic poem by selecting detached verses from the works of different poets. Others take a plan, and fancy it may be adapted to any situation; but, in reality, the plan must be made, not only to suit the spot, but it ought actually to be made on the spot, that every door and window may be adapted to the aspects and prospects of the situation. It was a remark of my venerable friend Mr. Carr of York, after fourscore years of experience as an architect, that to build a house we had only to provide all that was wanted and no more; then to place the best rooms to the best aspects and the best views. Simple as this apothegm may appear, it contains more truth in theory and more difficulty in practice than all the rules that have ever been laid down in books by architects, or the remarks of all the admirers of rural scenery, with whom I have conversed. The former never think of aspects, and the latter think of nothing but prospects. I will therefore beg leave to enlarge upon these two subjects.

"I consider the aspect of infinitely more consequence to the enjoyment and comfort of the inhabitant than any prospect whatever; and every common observer must be convinced that in this climate a southern aspect is most desirable; but few are aware of the total difference in the effect of turning the front of the house a few points to the east or to the west of the south; because, although the south-east is the best, yet the south-west is the worst of all possible aspects, for this reason, that all blustering winds and driving rains come from the south-west, and consequently the windows are so covered with wet as to render the landscape hardly visible. My attention was drawn to this subject by travelling so much in post carriages, and often remarking the difference betwixt the window to the south-west and the window to the south-east, during a shower of rain or immediately afterwards, when the sun shining on the drops, causes an unpleasant glitter, obstructing the prospect, while the view towards the south-east remains perfectly visible.

"At Organ Hall, in Hertfordshire, the living room was towards the south-west, and, during a heavy storm of wind and rain, we accidentally went into the butler's pantry, which looked towards the south-east, where we found the storm abated and the view from the windows perfectly clear and free from wet; but on returning into the other rooms, the storm appeared as violent as ever and the windows entirely covered with drops, which obstructed all view.

On considering the prevalence of south-west winds, it was determined to reverse the aspects of the house, by changing the uses of the rooms, thus making a very comfortable house of one which, from its aspect before, was hardly inhabitable, since no window, nor hardly any brick wall, will keep out the wet where a front is exposed to the south-west; for this reason, it has been found necessary, in many places, to cover the walls with slates, and to use double sashes to the windows so situated.



"If we had only one front or one aspect to consider, our difficulty would soon vanish; but the prevailing partiality for variety of prospect seems to require that in every direction the views should be retained; and as the opposite side must be parallel, and the corners, at right angles, we must consider the effect on each of the four sides as in the annexed diagram.

"First, the aspect due north is apt to be gloomy, because no sunshine ever cheers a room so placed.

"Secondly, the aspect due east is not much better, because there the sun only shines whilst we are in bed.

"Thirdly, the aspect due west is intolerable, from the excess of sun dazzling the eye through the greatest part of the day.

"Hence we may conclude that a square house placed with its fronts opposite the cardinal points, will have one good, and three bad aspects.

"Let us now consider the effect of turning the principal front towards the south-east; in this case the opposite front will be to the north-west, an aspect far better than either due north or due east; because some sunshine may be preserved, when its beams are less potent than in the west, and the scene will be illuminated by those catching lights so much studied by painters, especially where the landscape consists of large masses of forest trees, and thickets richly hanging down the side of an opposite hill. An aspect open to the north-east would be objectionable during the cold winds of spring, unless the building could be effectually sheltered by an impenetrable screen of trees, rising ground, or other defence against the wind."

The author further remarks that the south-west aspect should be sheltered by a plantation and the offices which should be erected in that situation, and again says: —

"It is very common for admirers of landscape or natural scenery, to overlook the difference between a tree and a pole, or between a grove of old trees and a plantation of young ones. We fancy that time will reconcile us to the difference: but alas! we grow old as fast as the trees, and while we dot and clump a few starving saplings on an open lawn, we indulge hopes of seeing trees, while, in fact, we only live to see the clumsy fence by which for many years they must be protected. Happy is the proprietor of the soil who becomes possessed of large trees, already growing on the land he purchases, since no price can buy the effect of years, or create a full-grown wood, and without this we may possess a garden or a shrubbery, but not a landscape. This consideration alone is sufficient to attach us to the venerable avenue, which it would be a sort of sacrilege to desert, and whose age and beauty will give an immediate degree of importance to the house, which could never be expected in any more open part of an estate."

TILING, SLATING, ROOF COVERING, ETC.

After ascertaining and deciding upon the most desirable prospect and situation for the erection of a building, providing for the drainage, and erecting the walls, the must important consideration is, to ascertain the best and most simple method of covering or roofing it, so

as to keep it secure and free from rain, damp or other injury. In doing this and keeping economy in view, the attention should be directed to the durability and weight of the material to be used. Therefore in determining the covering of roofs the following tables respecting the weight of roof covering materials will be found useful.

SLATES.

1 Ton of Westmoreland slates will cover	2	squares.
1 Ton of Welsh rag . . . $1^1/_2$ to	2	ditto.
1000 Duchess slates will cover	9	ditto.
1000 Countess ditto	5	ditto.
1000 Ladies ditto	$3^1/_4$	ditto.
1000 Tavistock ditto	$2^3/_4$	ditto.

One square of Westmoreland slates, or one square of Welsh rag, will weigh . 10 Gwt.

One square of Duchess, Countess, or Ladies slates will weigh . . . . 6 Cwt.

Slates are sold by long tale, therefore what is called one thousand is, in reality, twelve hundred.

	ft.	in.		ft.	in.
Welsh slates called doubles average .	1 „	1	by	0 „	6
Ladies	1 „	3	by	0 „	8
Countess	1 „	8	by	0 „	10
Duchess	2 „	0	by	1 „	0
Rags	3 „	0	by	2 „	0
Queens	3 „	0	by	2 „	0
Imperials	2 „	6	by	2 „	0
Patent	2 „	6	by	2 „	0

Inch thick planed slate weighs 14 pounds per ft. superficial.

TILING.

768 plane tiles at a	six inch guage will cover	1	square.
655 ditto	seven inch guage ditto	1	ditto.
576 ditto	eight inch guage ditto	1	ditto.
180 pan tiles	ten inch guage ditto	1	ditto.
150 ditto	twelve inch guage ditto	1	ditto.

A plane tile is $10^1/_2$ inches long, $6^1/_4$ inches wide, $^5/_8$ of an inch thick, and weighs 2 pounds 5 oz.

A pan-tile is $13^1/_2$ inches long, $9^1/_2$ inches wide, $^1/_2$ an inch thick, and weighs 4 pounds 11 oz.

1 square of plane tiles is 700, and weighs 14 cwt.

1 square of pan-tiles is 180, and weighs $7^1/_2$ cwt.

1 bundle of laths to one square of each.

WEIGHT OF ROOF COVERING.

	cwt.	qr.	lbs.
1 square of pan tiling will weigh	7 „	2 „	0
1 ditto of plane tiling	14 „	0 „	0
1 ditto Countees, Duchess, or Ladies slates	6 „	0 „	0
1 ditto Welsh Rags, or Westmoreland slates	10 „	0 „	0
1 ditto lead, 7 pounds to the foot	6 „	1 „	0
1 ditto lead, 5 pounds ditto	4 „	1 „	24
1 ditto copper	0 „	3 „	16
1 ditto zinc cast and rolled $^1/_{16}$th of an inch thic . . .	2 „	0 „	6
1 ditto zinc cast $^1/_{32}$nd of an inch	1 „	0 „	4

LEAD.

Lead $^1/_{16}$th	of an inch thick	weighs per ft. supl.	$3^3/_4$	lbs.
$^1/_{12}$	of an inch ditto	ditto	5	ditto.
$^1/_{10}$	of an inch ditto	ditto	6	ditto.
$^1/_8$	of an inch ditto	ditto	$7^1/_2$	ditto.
$^1/_6$	of an inch ditto	ditto	10	ditto.
$^1/_5$	of an inch ditto	ditto	12	ditto.
$^1/_4$	of an inch ditto	ditto	$14^3/_4$	ditto.
$^1/_3$	of an inch ditto	ditto	$19^3/_4$	ditto.
$^1/_2$	of an inch ditto	ditto	$29^1/_2$	ditto.
$^3/_4$	of an inch ditto	ditto	$44^1/_4$	ditto.
one inch	. . . .	. .	59	ditto.

There is another very new and efficient roof covering, which is the tubular tiles, patented by Norton and Borie; they consist of a plain tile perforated longitudinally by four tubular openings; the tiles are lipped on each edge reversedly (see Plate 24, Fig. 1), so that the edges drop into one another and are perfectly water tight. Fig. 2, Plate 24, is a drawing of the same tiles with the ends of the tubes closed; these tiles are fifteen inches long and $7^1/_2$ inches wide, so that with a guage of one foot there is a lap of three inches; therefore one hundred and sixty of them will cover one square; they weigh about $4^1/_4$ pounds each; making the weight per square 680 lbs. The advantages arising from a covering for roofs of this formation will be apparent to every reflective mind, and lengthened observations will not be required here to prove their great usefulness; it will only be necessary to expound briefly their leading claims to universal adoption.

Being non-conductors, the sun's rays on a roof of these tiles have little or no power beyond the outer surface, the heat being cut off by the presence of air in the tubes running all through the tile. The various practices, so frequently adopted with a view to keep down the temperature of the uppermost rooms in large buildings, factories, workshops, store rooms, farm buildings, dwelling houses, etc., are now no longer necessary, these tiles being sufficient for that purpose.

Those with the tubes left open are efficient ventilators, the air being admitted in the safest manner, that is to say, running upwards in the same direction as the roof.

It is also obvious that they are not liable to leakage, for should the outer plate get fractured the rain would be carried off by the chamber below.

The upright partitions give great strength, and they are lighter (for the same covering surface) than any other tile yet in use. In appearance they are more sightly, and are to be obtained at moderate prices.

Their strength has been proved by the following test: —

A tile weighing $4^1/_4$ lbs., 15 inches long and $7^1/_2$ inches wide, was placed with its ends resting upon two bricks, with a bearing at each end of 1 inch, leaving a clear bearing of 13 inches; this was loaded at its centre, when the breaking weight was found to be 4 cwt. 3 qs. 5 lbs., or 530 lbs.

Plate 24, Fig. 3, represents one of Norton and Borie's quadruple square-hole hollow-grooved bricks.

Plate 24, Fig. 4, represents tubular brick walls.

Plate 24, Fig. 5, represents the disposition of tubular or hollow bricks forming a very light and strong wall with large spaces inside.

Plate 24, Fig. 6, represents the position of the bricks at the angles of a wall built of double size tubular bricks.

Plate 24, Fig. 7, is the section of a ten-inch hollow or tubular brick wall with an improved coping tile.

Plate 24, Fig. 8, is the section of a 15 inch hollow or tubular brick wall coped by three coping tiles, two from the same mould, and differently moulded.

The strength of these bricks has been tested by the following satisfactory experiment, made upon four of the metropolitan or hollow bricks of the ordinary size, viz.: 9″ by $4^1/_2$″ and $2^3/_4$″, made out of the usual London clay. Planks were first laid for foundations, on which were laid four bricks bedded in cement, at a distance from each other of 10 feet and 7 feet. Two wood beams 16 feet long, 14 inches wide, and 8 inches thick, were placed edgeways upon the bricks, leaving at each end 1 inch of the bricks uncovered by the beams, and sufficient planks laid across these main beams. Bricks were piled up weighing 36 tons, until the foundation planks, yielding to the pressure, prevented laying more on, without the slightest injury to the bricks. They were left piled up for several weeks. Thus, an ordinary size brick perforated longitudinally will sustain, without danger, a column of any height that in building practice may be required.

If a roof be covered with common plain tiles they should be all well pinned and laid with moss, or hay bands; in most cases they are laid with lime and hair, but the other method is preferable. They form a very dry but heavy covering, and require a very steep pitch,

Slating is laid either upon battens or close boarding and forms an excellent roof covering. The duchess slate will cover to a guage of eleven inches with a weather lap of two inches. These duchess slates, which measure 24 inches long by 12 inches wide, should be trimmed, and the holes punched at $13^1/_2$ inches from the bottom edge or tail of the slate; if battened the battens should not be less than 3 inches in width, and at least $^3/_4$″ thick; this will be the form of the slate when laid. The first course or eaves must be laid 13 inches wide; these are called doubles, and are first laid before the other courses begin; see Figs. 1 and 2: —

Fig. 1.

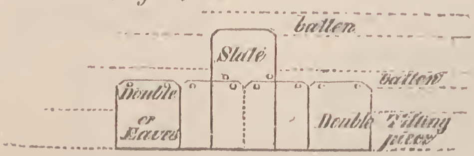
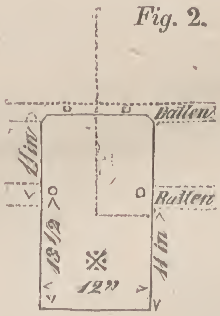
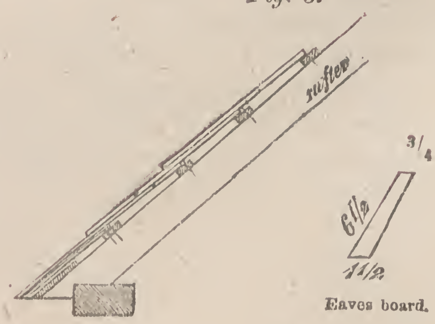


Fig. 2.



The eaves board or tilting piece should be featheredge and batten wide, $1^1/_2$ inch thick at the lower edge, and $^3/_4$″ thick at the upper; this cants the first row or eaves, leaving all the overlays without riding where nailed, which prevents the slate from gaping at the bottom edge, and letting the wind underneath: when this is the case the slate will chatter and ultimately get loose. The art of slate laying to perfection is, that the bottom edge of every slate should fit as close as possible to the backs of the two immediately underneath it, Fig. 3.

Fig. 3.



Eaves board.

8*

Where slates are cut up to party or parapet walls, a small feather edge fillet, about $^1/_2$ an inch thick and 2 inches in width, should be nailed upon the battens all up the wall, to throw the outside edge of the slates up, in order that the water should incline from the wall, and every wall slate should be cut angle-ways from the wall, see Fig. 4. The dotted lines shew the direction the water will take from the wall to the tail of the slate.

Fig. 4.

The battens for Duchess slating must be nailed down firmly to the rafters at a guage of eleven inches from centre of the battens. One hundred and thirty two of these slates will cover one square.

In measuring slating, one foot extra is allowed for all eaves, and six inches for all cutting to hips, valleys, or walls; should smaller slates be used, one half of the width of the slate should be allowed for cutting.

The hips and ridges of slated roofs are generally covered with lead; but a very neat and economical finish can be made with slate fillets two inches wide, or of sufficient width to cover the ridge board or hips, which should be kept down so that the heads of the finishing course of slates should first rest upon them; the ridge board and hips, as well as the heads of the slates and nails, to be painted, and flat fillets of slate bedded in putty upon them, and the putty cut close; the finish looks very neat. A large roof finished in this manner with black putty, twenty seven years ago, is as perfect now as when it was done; each fillet should have two nail-holes at equal distance from the ends, and overlay each other, so that one nail secures the ends of two fillets. (See diagrams Fig. 1, 2, 3.)

Fig. 1

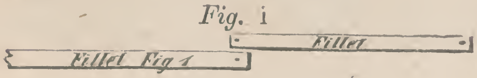


Fig. 2.

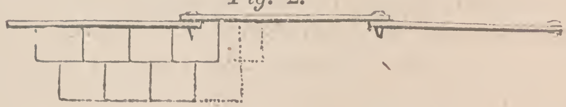


Fig. 3.

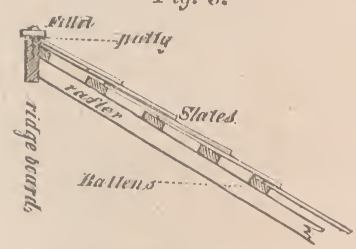


Fig. 1. Shews the fillets about two feet in length, and of width sufficient to cover the nails of the heading or finishing course of slates.

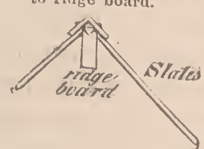
Fig. 2. Represents them bedded in putty and nailed down to the ridge or hip, each nail securing two ends.

Fig. 3. Represents a section of the rafter, battens, slate, and ridge, with the fillet also nailed down.

Another method of finishing hips and ridges, is by nailing on sloping fillets of slate, meeting together over the ridge; but this method does not keep the roof dry, although the wet that enters between the joints may be but trifling.

In this method of finishing, the ridge board must be kept up higher than the heading slates, to allow the edges to be bevelled off to form a bed for the slate fillet: see diagram Fig. 4.

Fig. 4.
Fillets nailed sideways to ridge board.



There are various ornamental tile and slat ridges to be obtained, suitable for every description of building; these are of various patterns, from the light pinnacle ridge of unquestionable beauty, to the common ridge tile painted with lead-color paint.

PLAN AND ELEVATION OF A SIX-ROOMED HOUSE.

PLATE 25.

Fig. 1. Elevation. Fig. 2. Ground plan. This plan comprises, on the ground-floor:—

An entrance hall or passage	8 ft. 6 in. by 3 ft. 6 in.
Opening on the right to a front parlor	12 „ 0 „ by 10 „ 0 „
A staircase with cellar underneath, excavated two feet for beer and coals	12 „ 0 „ by 3 „ 0 „
A living room	12 „ 0 „ by 10 „ 0 „
A pantry	4 „ 6 „ by 3 „ 0 „
A kitchen or washhouse, with copper, pump, sink, and water-closet	9 „ 0 „ by 7 „ 0 „
The upper floor contains:—	
A front bedroom	12 „ 0 „ by 10 „ 0 „
A back ditto	12 „ 0 „ by 10 „ 0 „
A large linen closet	4 „ 6 „ by 3 „ 0 „
A small bedroom over the kitchen	9 „ 0 „ by 7 „ 0 „

The height of the ceilings to be nine feet, above the ground-floors, and eight feet nine inches above the upper floors; there is a fall of two steps into the kitchen, and the same from the back bedroom into the small bedroom. This building can be erected for a trifle under two hundred pounds; and is adapted for a freehold allotment with a frontage of twenty-five feet, leaving a gateway entrance of nine feet.

ELEVATION OF A FARM HOUSE AND OFFICES.

(SEE PLATE 46, FIG. 1.)

DESCRIPTION.

The ground plan (see Plan 47) of the principal building of this Plate, will occupy a frontage of thirty-one feet, by a depth of thirty-two feet, and the walls will be of one and a half brick-work from the ground-floor to the plate of the roof.

The front door, which is to have the upper panels and the light over them glazed with plate glass, will be entered from a neat porch with a stone landing, raised four steps from the surface level.

The front door enters on a hall, or passage, thirty feet long by four feet six inches in width, leading to the back door, which is also to have the upper panels glazed as well as the light over it.

From the front entrance, on the left, there is a best parlor, twelve feet by fourteen feet six inches.

On the right there is a breakfast parlor twelve feet by twelve feet; on the left, opposite to the kitchen door, is the living room or dining parlor, twelve feet by fourteen feet six inches, and an entrance to a counting-house, seed room, or office, 12 ft. by 10 ft. The height of the ceilings of this floor will be nine feet six inches in the clear.

On the right is a kitchen twelve feet by twelve feet; between the kitchen and breakfast parlor, are the stairs, with water-closet, all well lighted by the ornamental windows in the flank wall, between the projecting chimneys and the office building; the stairs lead to the bedroom floor, which contains (see Plate 46, Fig. 2):—

A drawing room	16 ft. 6 in. by 12 ft. 0 in.
A front bedroom	14 „ 6 „ by 12 „ 0 „
One back ditto over kitchen	12 „ 0 „ by 11 „ 0 „
A small room over the passage	9 „ 0 „ by 6 „ 6 „
Another back bedroom	14 „ 6 „ by 12 „ 0 „
And leading from this a private bedroom or young Ladies' or infants'-room over the office	12 „ 0 „ by 10 „ 0 „

The height of the ceilings of this floor to be nine feet in the clear.

The two back quarter partitions, which divide the single bedroom from the two back bedrooms, joggle over the partitions under them one foot each way, taking one foot from each back bedroom to make the small room useful. A large linen closet may be formed on the landing of the staircase, with a good light from the staircase window. Under the spandrel of the first flight of stairs will be found sufficient space for the housemaid's brooms, brushes, and dry ware. From the kitchen, dropping four steps, is a passage sixty feet long by three feet wide, leading to the following offices (see Plate 47):

A store room, eleven feet, by seven feet.
A larder, the same size.
A scullery or back kitchen, ten feet by eleven feet.
A brewhouse or laundry, eleven feet by ten feet.
A dairy, the same size.
A cellar, seven feet by eleven feet.
A coal house, and wood ditto, eleven feet by six feet.

At the end of this passage a door in front leads to a small inclosure with a water-closet, and, on the left, another door opens into the yard.

The joists of this range of buildings are to be 8 inches by 2 inches, one foot apart, and to project one foot six inches beyond the outside of the walls on each side, to support a pole plate notched upon them four inches from their ends, upon which the rafters are to stand, (see Plate 46, Fig. 3.,) and each rafter is to be connected to the joists by Queen struts, leaving a space of three feet clear. The whole is to be floored with rough two-cut white spruce battens, well seasoned, with their edges shot straight. The sides and under part of rafters to be boarded with half-inch match boarding, forming a loft or granary sixty-three feet long, twelve feet wide, and eight feet six inches high in the centre; with an entrance over the brewhouse from the paved yard. Light is obtained from a window opposite to the entrance, and the ornamental window at each end.

Another entrance may be made to the granary loft from the stack yard, opposite to the one before described. A clock may be fixed in the pediment over the entrance from the paved yard, and a weathercock and vane over the intersection of the ridge, being a position conspicuous from the principal, inhabited, and business part of the premises.

Passing from the left hand back-door, a range of buildings commences: first, a chaise house and stable, a loose box, a five-stall stable, a four-stall cow-house, a large barn, with roof brought down to form cart-sheds, fodder houses, poultry house, and pig-sties.

The stables, cow-houses, and pig-sties open to the farmyard out of sight of the house; and at the most convenient corner the liquid manure tank must be sunk, and an iron pump fixed therein of sufficient height to fill carts. The manure tank must be so situated as to receive conveniently the whole of the drains from the residence, water-closet, and offices, stables, cow-sheds, and pig-sties, as well as the drainage from the straw and dung yards. The tank should be soundly laid with brick in cement, on a thick clay bottom well puddled, and then arched over, and have a small deep tank within it, two feet lower than the bottom, to receive the heel of the iron pump. The dung or straw yard, should incline each

way towards the middle, to drain to the pipe drains leading to the tank, and should be formed with a sound bottom of broken chalk, well rammed and punned down, at least twelve inches in thickness when finished, so that all rain that falls therein will drain to the centre, and carry with it into the sewage tank all the constituent particles of the dung, which may be taken up by the water.

MANURES.

The importance of a chemical knowledge of the constituent particles of manures, and their effect in the production of the vegetable kingdom, is of the utmost consequence.*

"The well-being and happiness of animal life, according to the ordinations of the Almighty, pre-supposes the necessity of vegetable existence. The first requirement for an animal is food. That food must be obtained directly or indirectly from the vegetable world. We can well understand how closely linked are the sympathies of the one in connection with the other. As in the whole universe, so do we find it here, that the great scheme of created intelligence and wisdom is one of mutual dependence,—man upon the lower orders of creation,—plants upon the mineral world: one cannot possibly exist without the other; hence the unfruitfulness or paucity of the one is immediately felt and experienced by the other. We dismiss, with these remarks, the consideration of the all-importanc supply of gaseous food both to plants and animals, merely wishing to point out the precise relations of their co-existence.

"Man is dependant entirely, either directly or indirectly, upon vegetable substance. Thus, directly, on the plants and fruits of the vegetable tribe; and indirectly, by means of the carnivorous and graminivorous animals,—these mediums being, as it were, steps in the preparation and elaboration of his food, to that point which is most correspondent to the wants of the human frame and their immediate supply. In the graminivorous animals, the step is but one from the vegetable; in the carnivorous, the distance is more removed.

"Plants, then, we may justly conclude, are the source of food for all animals, and the fruitful state of vegetable existence an enquiry well fitting all mankind; the support of these kingdoms, as provided for man, is arranged in a most exemplary manner, and is explicative of the foresight and intelligence of an all-wise Creator; but man cannot rest in the normal state, nor can his wants be met by the vegetable world in its normal condition. Primitively, plants found the whole of their subsistence from the natural sources presented to them in the soil; when, however, the productiveness of the plant is increased, and we develope by high cultivation the various parts of the vegetable system (more especially those containing nitrogenous principles) to an abnormal extent, then it is found necessary to supply the waste which takes place continually in the soil, in order to render that soil once more productive. This is carried out in the principle of manuring.

"A manure, then, is some substance presented to land to make that land more productive.

"If we consider the constituents of plants and soils, we shall find that manures, in general, need only be of one or two characters; and in particular, that a manure cannot become a specific, although it may be so varied as to suit the wants of any crop upon any land. People sometimes imagine that because a substance is a manure, that alone is quite sufficient to further the productiveness of any crop and upon any land. In consequence of this, we are sometimes annoyed at the pertinacity of those who declare, beyond all reasoning, that a manure must necessarily be bad because it has failed, in a particular experiment. I have known Guano—

* Our readers are indebted to E. V. Gardner, Analytical Chemist, London, for this valuable information.

certainly the best fertilizer, if good and not debased by manufacture,—to act in a manner positively injurious in some situations, and to have been in some measure despised; and why? not because of the imperfection of the manure, but because of the ignorance of the party who happened to employ it upon an unsuitable or unseasonable position. Each plant is made up of certain constituents. To live and thrive, the plant must exist in a soil containing such constituents. It is not sufficient that one or other be present; it is necessary that all should be there to supply the wants of the plant during growth.

"In the same manner, with regard to ourselves, we require elements of nutrition, and elements of respiration: we cannot do with one without the other: each is vitally important; nor can either be dispensed with. So, likewise, is it with the vegetable world, for they require different elements to fulfil different functions: the lack of one of them immediately breaks the harmony of the whole. Plants are principally composed of carbon, oxygen, hydrogen, and nitrogen,—with the exception of a few grains per cent., entirely so,—and none of them are obtained from the soil, the office of the latter being to afford a supply of the inorganic constituents, the few grains per cent. to which we have alluded. Whence is derived the principal elements of plants? From the atmosphere alone. Curious, nay, startling as it may appear, this fact is evidenced, not only by scientific experiment, but by direct observation. The forest, with its huge monsters of a hundred years' tenancy, does not decrease in verdure. The soil does not diminish, but, on the contrary, is increased year by year by the decaying leaves and branches. Were the materials of which these leaves and branches are composed, taken originally from the soil, we should find that soil, shewing by its sterility and diminution, evidence of the fact. This is not the case, as we stated; the soil becomes increased, and that increase was originally obtained from gases existing in the air. The matters taken from the soil are of so small an amount, that, in comparison, they would appear unimportant. We are taught by nature that however insignificant the quantity, the supply is vitally important, and must exist. It is the province of the soil to yield these inorganic elements according to the requirements of the plant. When by high cultivation we increase the growth of a crop beyond the means supplied by nature in the production of food, then it is we must make up the deficiency; and this is effected by manures.

"The remaining constituents of plants comprise sand, oxyde of iron, oxyde of manganese, potash, soda, lime, magnesia, phosphoric and sulphuric acids, chlorine and, perhaps one or two others, depending upon local causes. Of these the most important (if we can apply the term to some elements of a plant above others), or rather the most universal, are potash and phosphoric acid: these two are always present in plants; if we look for the supply, we find it in the primitive rocks throughout the world; with these are generally found the oxydes of iron and manganese. The calcareous rocks, with the common salt deposits, furnish us with the remaining portion of a plant's constituents.

"For the supply of these constituents Nature has abundantly provided; in her great laboratory, the force of wind and water, the eruptions of volcanos, the heaving fracture or dislocation of the solid strata of the earth, are all agents in mixing up these ingredients one with another, and producing what we term soils. One plant requires one series of elements, another requires elements quite distinct. The primitive condition of a productive soil is fitted for one and all alike. If, however, we remove by constant cropping with the same plant, particular elements from the soil, the soil becomes weakened and can no longer afford nourishment for that crop, the elements of which have been so far consumed from out of the soil as to leave others in great proportion; the latter not being those required for the plant, change the crop, plant in the same soil a vegetable of different constitution, and it will thrive most vigorously, because that soil then contains a redundancy of its particular food. This explains the principle upon which is founded the system of rotation in cropping.

The description of the adjacent buildings is also to be inquired into; as factories and other structures in which there may be a great noise during the week would tend to disturb congregations who may meet on other days than Sundays. Nuisances are caused by the carrying on of some trades, all of which circumstances should receive due consideration prior to the selection of a site. Places of worship also must not be placed in localities too removed from the people who are anticipated to frequent them; otherwise, when the weather is at all inclement, they will be liable to be deserted. Sir Christopher Wren, whose experience in the erection of churches was, as is sufficiently well known, of the most extensive description, makes the following sensible remarks. "As to the situation of churches, I should propose they be brought as forward as possible into the larger and more open streets, not in obscure lanes, and where coaches will be much obstructed in the passage. Nor are we, I think, too nicely to observe east or west in the position, unless it falls out properly; such fronts as shall happen to lie most open to view should be adorned with porticoes, both for beauty and convenience; which, together with handsome spires and lanterns, rising in good proportion above the neighbouring houses (of which I have given several examples in the city of different forms), may be of sufficient ornament to the town, without a great expense for enriching the outward walls of the churches, in which plainess and duration ought principally, if not wholly, to be studied."

With respect to the size of places of worship, it will be regulated by the number they are proposed to contain, but it is an important point to know how many persons can be accomodated so that all may see and hear distinctly, and this is the especial respect in which many modern structures entirely fail. The defect has arisen from the foolish practice of copying Roman Catholic Churches, and the effort to rival their spacious magnificence.

"The Romanists," said Wren, "built large churches — it was enough if they heard the murmur of the mass and saw the elevation of the host — but ours are not to be fitted up for auditories. I can hardly think it practicable to make a single room so capacious as to hold above two thousand persons, and all to hear the service and see the preacher. A church should therefore be ninety feet long and sixty feet broad, besides a chancel at one end and a belfry, or portico, at the other." It would have been well if Wren had always practised the rules he laid down. The splendid inutility of St. Paul's is obvious to all: and it is surprising that such a man could have erected a Roman Catholic cathedral for a Protestant nation. We may mention that Exeter Hall, admirably adapted for sight and hearing, is 131 ft. 6 in. by 76 ft. 9 in. and 52 ft. 4 in. high: 2300 is the greatest number ever in it exclusive of those in the orchestra, making altogether 2800 persons. Wren mentions St. James's Westminster, as holding 2000 persons, "in the cheapest form" he could invent. "Concerning the placing of the pulpit," he remarks, "a moderate voice may be heard fifty feet distant before the preacher, thirty feet on each side, and twenty behind the pulpit; and not this, unless the pronunciation be distinct and equal, without losing the voice at the last word of the sentence, which is commonly emphatical, and, if obscured, spoils the whole sense. To build more room than that every person may conveniently hear and see, is to create noise and confusion." If there are galleries, the space between them should not be less than twenty-four feet, or at the least half the whole width of the room; the height under should not be less than ten feet.

With regard to the arrangement and the placing of the seats, the Commissioners for the erection of churches lay down the rule, that "in order to provide accomodation for kneeling during public service, the space in each pew and free seat must not be less than two feet eleven inches in the clear, when the height does not exceed three feet two inches from the floor of the pew, nor less than three feet if the height be greater; but the width of two feet six inches may be admitted if the back of the seats be not more than two feet eight inches high; twenty inches to be allowed for adults and fourteen inches for children." The pulpit and desk are recommended divided and to obscure the altar as little as possible; no square and double pews are permitted,

and all seats are to face the same way. Benches are to have backs inclining about three inches, and elbows are to be provided. The free sittings and pews should be intermixed as much as possible, in order that there may be little separation of rich and poor; and Wren says, — "A church should not be so filled with pews, but that the poor may have room enough to stand and sit." Fonts are generally placed at the west end of churches, and Robing Rooms are often provided with doors of access from without. Particulars of the construction generally will be found further on, but we may here remark that the Commissioners above mentioned require walls; —

	Ft.	In.
If of brick, not exceeding 20 feet in height and sustaining a roof of not more than twenty feet span	1 „	$10^1/_2$
If the height be more than twenty feet and the span of the roof to be sustained exceed 20 feet	2 „	3
If the height be more than 30 feet	2 „	$7^1/_2$

If the walls are of other materials, they are to be increased according to their quality.

We shall now proceed to a brief description of the design given.

Plate 30. contains plans of Ground and Gallery Floors of the Chapel. The extreme internal dimensions are 72 by 52 feet. There is a covered vestibule, the advantage of which is obvious. Doors on both sides lead to staircases conducting to the Galleries. Three central doors lead into the body of the Chapel, and within these are lobbies and additional doors, thus deadening the entrance of noise from without and preserving warmth. The entrances to the central and side aisles and galleries are kept distinct to prevent the crowding caused by the meeting of different streams of people. If preferred, doors may be placed leading from the side aisles into the staircase lobbies; but there will be the objection of the contact of the people from the galleries and side aisles, and the arrangement shown will be found most convenient. Two Robing Rooms, with fireplaces and W. Cs., or closet and W. C., are shown under the galleries. The pews are of different and convenient sizes, and the seats for children occupy the cross gallery in front of the organ. The pulpit and clerk's desk are connected together and placed centrally as most conducive to sight and hearing. The gallery is supported on iron columns, which, although they have always a tenuous, poor and often unsubstantial appearance, are advantageous in obscuring as little as possible the officiating minister. The font is placed at an angle of the chapel in an open space appropriated to it.

Plates 31, and 32, contain the Front and Side Elevations, and Transverse and Longitudinal Sections, showing the general construction and decorative effect. The Elevations are in Italian architecture with an admixture of Greek feeling; and it has been endeavoured to give to them the peculiar character now generally sought to be obtained in Chapels of this description.

The construction as shown in the Sections is extremely simple. The roof is to be of iron and wood, and the character of the cornice and ceiling and the degree of its enrichment will depend on the funds at command, and the taste and feeling of the proprietor.

Plates 33. to 37. contain the working details, but before describing them, we will make some remarks on the general construction.

Concrete is not shown to the foundations. If required, it may be 3 feet deep and twice the width of the lowest course of footings. It is to be composed of 6 gravel to 1 lime, tipped over from the barrow at the lowest possible level, and no other materials should be substituted.

The walls are to be built of the thicknesses and with footings in the manner shown. Good sound stock bricks to be used with what facing of brickwork shows of second malms, the joints raked out and tuckpointed. The arches are to be turned in half brick rings, and all requisite centring is to be provided and not to be struck until directed. Form fireplaces, flues, bricknogged partitions to W. C. and generally complete brickwork as shown.

The mortar to be composed of fresh burnt lime and clean pure sand in the proportion of 1 to 3,

well mixed together and chafed in a pug-mill. The drains to be 4 inch stoneware, with syphon traps, and all requisite bends, junctions, etc.

Tyerman's patent hoop iron bond, $1^3/_4$" wide, is to be used in tiers of two courses every 6 feet. It may be procured for 8 shillings per thousand feet above the current price of hoop iron and is a considerable improvement on the old bond. The external plastering is to be run, moulded and finished in the best Portland cement, 1 cement to 2 clean sharp sand; it is to be brought up to an uniform face, the arrises accurately cut, the moulds for the cornice to be approved previous to use, and the surface ultimately well fined off with fine white sand.

The internal plastering to be of good stucco worked to a fine sandy surface, the walls being previously rendered, set and floated to receive the stucco. Put Portland cement skirting (1 cement to 2 sand) where wood skirtings are not described and to pilasters, etc., at Communion space. The ceilings to be lathed, plastered, floated, set and whited.

The Mason is to work in self-faced York cores where requisite to the cornices, both edges coped parallel and the joints squared and set in cement.

York landings and granite bases are to be provided for the cast iron columns, with stub holes sunk for the bases as shown on Plate 35.

The steps at entrance to be rubbed York, in as long lengths as possible, breaking joints; and the paving to vestibules and aisles is to be 3 inch rubbed York, in parallel courses, bedded and jointed in mortar on ground well rammed, dry rubbish, or concrete.

The staircases to have Portland stone spandril steps, back-jointed, worked fair all round and rubbed, with moulded nosings continued round, and curtail bottom steps.

The landings to be 6 inches thick, with joggled joints set in cement, rubbed both sides, and, together with the steps, tailing into the wall 9 inches and securely pinned up; cut holes for iron balusters.

Provide chimney pieces, with slabs and hearths, and every requisite, to render the Mason's work complete and perfect.

The fir timber to be sound yellow Riga, Dantzic or Memel, free from every defect, and thoroughly seasoned. The oak to be English, and the deals to be hearty, sound, Christiana, free from sap, shakes, wainey edges, and loose knots.

The carpenter is to provide all scaffolding, centring, turning pieces, etc., and to erect a hoard and office for clerk of the works. The framing is to be put together in the manner shown; the principal timbers to bear as much as possible on the walls, the joists and rafters not to exceed 14 inches from centre to centre; the plates to be lapped at the angles, and to continue to 9 inches from the outer face of the walls; all lintels to be 6 inches deep; and the ceilings to be made perfectly level before lathing for plastering.

The roof is shown on Plate 33, and is to be framed and put together in the manner indicated with timbers of the following scantlings.

Tie Beam	15 >< 9	inches.
Principals	12 >< 9	"
Struts and Crosspieces	7 >< 6	"
Small Queen Posts	9 >< 6	"
Straining Piece	12 >< 9	"
Purlins	8 >< $4^1/_2$	"
Rafters	5 >< $2^1/_2$	"
Joists to flat averaging	9 >< $2^1/_2$	"
Ceiling Joists	5 >< $2^1/_2$	"
Plates	5 >< 5	"

Horizontal tie beams ought always to be used in roofs of wide span, whether open or not; and the intervals between the trusses should not exceed ten feet; unless intermediate trusses are

introduced. No rafters or joists should exceed 12 inches apart. The boarding to flats to be inch close-jointed, with $2^1/_2$" rounded rolls to ridge, running across, 2' „ 6" apart, and to junction of slope of roof and flat. The boarding of gutters, which are nowhere to be less than 12 inches wide, is to be similar, laid to a current of 2 inches in 10 feet, with rebated drips 10 feet apart; cesspools 12 inches wide and 3 inches deep, with proper stout framed bearers. The flat over entrance vestibule to be similar, or joints 9" $\times$ $2^1/_2$".

All the ironwork to be as shown and to be provided by the Founder. The bolts to have proper screws, with good clean thread of coarseness proportioned to their diameter. The nuts must fit accurately without the least shake or play and be at least equal to twice the diameter of the bolt; proper washers are to be provided. The dovetailed formed heads, or sockets, and those at the feet of Queen bolts, together with the abutment plates and shoes for purlins, are sufficiently explained on the plate.

The joists to flooring of pews and also those to the Communion space and Vestry floors are to be of oak, $4^1/_2$" $\times$ 3", and are to rest on, or to be tenoned into, plates of the same scantling; but those to the Vestries are to be 3" $\times$ 3". Wrought strutting is to be provided, and no joists are to exceed 12 inches apart.

The Galleries are to be framed and supported in the manner shown on Plate 35. Bressummers 14" $\times$ 6", bolted to iron plate with $^3/_4$" bolts in the manner indicated. Binders, framed into or resting on bressummers, 12" $\times$ 6", and further secured with $^3/_8$" plate and bolts. The principals and straining pieces shown on the left hand side detail are to be 6" $\times$ 5", with dovetail-formed iron heads, inch bolts and $^3/_4$" bolts at feet of principals. The joists resting on truss are to be 8" $\times$ 3", as also the upper ones to passage; the smaller joists are to be 4" $\times$ $2^1/_2$". the joists in the right hand side detail are to be elongated as shown. Ceiling joists notched on to binders $4^1/_2$" $\times$ $2^1/_2$". The Floors to the Galleries, Pews and Communion space are to be inch $^1/_4$ yellow deal, straight joint, with inch $^1/_4$ deal rounded and grooved nosing and inch deal rebated risers to steps. The Vestries to have similar flooring, with splayed heading joints and mitred borders to slab.

The Partitioning at entrance to have 2 inch deal stiles, rails and muntons, struck with cavetto and ploughed for projecting beads, with $^5/_8$" deal panels. The doors in this partition to be flush framed, prepared to receive Yorkshire grey cloth, fixed with brass astragals in panels, and hung on brass butts, as are also to be the Gallery and Vestry doors, hung to $1^1/_2$" jamb linings, with architraves on both sides.

Gallery fronts should not be plastered; those in this instance are to be $1^1/_2$ inch stop chamfered framing, filled in with $^3/_4$" matched, ploughed, tongued, and beaded boarding. Capping of wainscot to be provided to it of a section to be approved. The lower framing and finishing of the Gallery front is shown on Plate 35.

The Walls round Gallery, and the walls on the Ground Floor not abutted against by pews, are to have linings 3 feet high of $^3/_4$" upright battens, grooved, tongued and beaded, with plain wainscot capping and 6" torus skirting, nailed to grounds built in brickwork. Tar this lining at the back.

The Entrance doors are shown on Plate 34. They are to have upright, rebated and twice beaded door frames 6" $\times$ 5", extending round fanlight and tenoned into mortice in paving below; transon 5" $\times$ 4", double rebated and beaded three edges, with $2^1/_2$" moulded frame for fanlight and bead for fixing ironwork. The door to be $2^1/_2$" thick, framed in the manner shown, and to be provided with fastenings of the value of 25*s*.

One of the windows is shown on Plate 34, and the others are to be of a similar character. Solid frames, wrought, framed, moulded and beaded as detail, grooved for inch rebated and rounding linings on splay, with circular head and zinc bars let into frame as shown to take glass. Sunk, beaded and groved sill, ploughed for rebated and rounded window board.

The W. Cs are to be fitted in the ordinary manner as described in former specifications. The windows are to have cast iron sashes made to open.

Open seats are now very general in churches, and if they have doors, these, together with the backs of the seats, are kept very low. On these divisions, a considerable amount of decoration in the panelling and carving is often lavished, and the pulpit and reading desks are sometimes very elaborate specimens of art. The *poppy heads*, or ornaments on the top of the upright ends or elbows which terminate seats, give rise to endless varieties of designs, *fleur de lis*, flowers, animals, figures, etc. These are common in Gothic architecture; but in some old churches in London very richly carved pews and pulpits of elaborate design are found. On plate 11, will be found some details of open seats; and as pews are preferred in chapels, we have devoted plate 36, to details of a plain example likely to be practically useful. For carved work generally, oak unpainted is undoubtedly preferable to fir. Yellow deal is proposed in the example now given. The panels should not exceed eleven inches in width; seven is desirable. Inch $^1/_2$ beaded enclosing partitions, one panel high (two are common), inch $^1/_2$ bolection moulded and bead flush doors, with bottom rails 6 inches wide, and stiles, top rails and munnions 4 inches wide, hung on 3 inch brass butts with projecting knuckles, and provided with brass knob pulpit latches. Details of panel and meeting stiles of doors are given half full size. Wainscot capping, as detail, half real size, moulded and grooved to tongue in partitioning. This capping is to cover all the enclosure, as well as the doors. The upright framing is to be secured to the floor and steadied by means of angle irons and screws, placed where most out of sight. The framing of the tread below is to be tenoned into the riser, but this and the flooring has been before described. Inch $^1/_4$ seats, rounded on the outer edge, 13 inches wide, curved towards door as shown. Inch $^1/_2$ cut brackets to support seats, from 2′ „ 6″ to 3′ „ 0″ apart, with chamfered bearers at ends against sides of pews. The flap seats are to have strong joints and are to be hung with butts or strap hinges. $^3/_4$ inch book boards, 6 inches wide, with $^1/_2$ inch rounded capping, tongued into groove in book board, and $^1/_2$ inch cut brackets about the same distance apart as those to the seats. The ends of book boards are to be rounded as indicated next to the pew doors to give space on entering. The children's seats and those round galleries are to be as shown on Plate 35, 11 inches wide, rounded on front edge, with no backs; the cut brackets to be of the distance apart above described, and all to be out of inch $^1/_4$ stuff. Free seats (if any are introduced) are not to be inclosed. They are to be out of inch $^1/_2$ deal, with sloping backs, framed with stop-chamfered stiles, munnions and rails, 4 inches wide, with similar standards, ends and chamfered bearers. The seats and brackets may be as described for the pews.

The organ is to be inclosed with framing and door similar to that described for the pews. For the organ itself we need give no description; it should of course correspond in the style of its decoration with that of the general design of the chapel.

The pulpit given on Plate 37, is to be of inch $^3/_4$, or two inch deal, framed and put together as shown, with bold beads at angles, and bolection moulded and bead flush framing, the inner beads being omitted in the lower inclosed part. The door is to correspond and be hung on similar butts to the pews, with brass pulpit latch. Put round top wainscot capping of the profile shown, ploughed to tongue on framing. The mouldings and skirting to be of deal as indicated. Strong rough framing within to support pulpit, and inch deal floors on joists 12 inches apart and of a scanthing of 4″ $\times$ $2^1/_4$″. Inch treads, grooved to similar rebated risers, moulded returned nosings, $1^1/_4$″ cut, sunk and beaded string board, the risers tailing through pulpit where next to it. Strong fir carriages and curtail end to bottom step. The staircase to be rounded as shown on the plan, and the underside is to be covered $^3/_4$″ matched and beaded boarding. Moulded handrail as to stairs to Galleries and newel of wainscot, with turned and mitred cap; square bar dovetailed balusters, two to each step, four to be of iron, with core, plate and screws. The seat within pulpit is to be of inch $^1/_2$ deal rounded, with proper bearers and cut bracket.

The book board is to be of inch $^1/_2$ deal with $^3/_4$" rounded capping, rebated into groove in board; it is to be supported by the cut brackets and bearer in the manner delineated. The Clerk's desk is to have similar framing to the pulpit, returned at both ends, with torns skirting, secured to floor with angle irons. This floor, together with the treads, risers, and joists, is to be similar to that described to the pews. The book board is to be as that specified for the pulpit. The seat is to have inch $^3/_4$ wrought, cut and stop-chamfered ends or elbows as design; the lower part is to be of $2^1/_2$" deal, chamfered, rebated into groove in boarding and ploughed for tongue of part above. The seat is to be of inch $^1/_2$ stuff, with rounded edge and supported on chamfered bearers, or grooved into elbows.

The Communion rail and the seats etc. will be as preferred; the rail may be of iron or wood; but we do not specify the fittings to this part, as they depend on the appropriation of the chapel.

The cast iron for the columns, etc., is to be of the best soft grey metal, mixed if needful with a small portion of hard metal to stiffen it. The columns are shown in detail on Plate 35, together with the plates, bolts and mode of fixing. They are to be provided by the Founder, together with the other ironwork shown on the Plate, and that to the roof on Plate 33. $3^1/_2$ inch cast iron down pipes are also to be provided to the roofs, and they should be always outside the walls. Wrought iron, or wainscot rails to the stone staircases and upright bars 3 feet high, or of an ornamental pattern as may be preferred.

The lead to the flats to be 7 lbs. to the foot super and 6 lbs. to the gutters, hips and ridges; 4" socket pipes from cesspools into heads of rain water pipes. The lead is to be laid loose, free to expand and contract. The W. C. apparatus is to be of the ordinary description.

The woodwork where seen is to have three coats of paint, and the pews, pulpit, gallery front, woodwork of communion space, wall lining, skirtings, where not inclosed, inside woodwork of windows, outer part of entrance doors and organ, are to be grained wainscot in addition and twice varnished in copal. The remaining woodwork usually painted, together with the ironwork and the ornamental cement work at back of communion space, are to be finished stone or some other common colour. If the pewing, etc., is of wainscot, it is to be sized and twice varnished. If of deal it may be stained with some of the common stains, which may be procured for about 6 shillings per gallon.

The windows are to be glazed with Hartley's rough plate glass, $^3/_8$ inch thick in squares of the sizes shown, and by using which the necessity for blinds will be obviated. The Commissioners for the erection of churches require two casements to be placed in each alternate window of churches, one to ventilate the space above the galleries and the other that below when, as is too often the case, the galleries cut the windows in two, producing an effect in the highest degree unsatisfactory. As will have been perceived in our article on Ventilation, the adoption of the system recommended by the Commissioners is fraught with the greatest evil in churches containing heated congregations. The cold air, rushing in, falls like a cascade on the heads of those below, and a temporary cold is the least evil to be anticipated from the sudden chill.

The roof may be covered with Countess slating, laid on $^3/_4$" battens $2^1/_2$" wide and nailed with copper nails, or zinc (cheaper), two to each slate, every third slate to overlap the first 2 inches.

We shall not here enter into the subject of warming and ventilating places of worship, as two articles are devoted to the consideration generally of those subjects. Whatever the system adopted, it should be determined before the edifice is commenced, as subsequent alterations involve increased expenditure, and no system can be carried out so satisfactorily after the completion of the works as during their progress. All requisite flues should be provided, and care must be taken not to build any combustible materials into or close to them. Iron pipes are exceedingly dangerous. The fact has never been clearly explained, but it is nevertheless true, that there is a chemical action between hot iron and timber, the tendency of which is to generate ignition at a less temperature than is ordinarily necessary. This is true of hot water pipes; and

the concealment of them often prevents the discovery in time of the impending danger. All pipes for heating should therefore be kept as distant as possible from timber, and a casing of woodwork is a species of incendiarism, if we may use the term. The spaces beneath boarded floors should be amply ventilated, and the water on the windows resulting from condensation, should be conducted by means of small channels outside the building. A church or chapel can hardly be very healthy when a number of bodies are decaying in the vaults beneath. "I could wish," remarked Sir Christopher Wren, "that all burials in churches were disallowed; it continually disturbs the pavement and is besides unwholesome. I could also desire to see the burial ground at a distance from the church: cemeteries might be formed in the outskirts of London, of two acres extent, having one walk all round, and two cross walks, planted with yew trees. These four divisions would serve four parishes. There beautiful monuments might be erected, but the dimensions should all be determined, else the rich, with their large marble tombs, would shoulder out the poor." This system is now being carried out; but while others obtain credit for it, few are aware of its having been so long ago suggested by one whose views were in this respect as much in advance of his time as his humanity contrasts strongly with the prejudices of those who think they can never rest quietly unless in the family vault, with the organ loudly pealing as the voices of the living rise up in a prayer above.

In erecting churches and chapels it should be borne in mind that wood linings are the best conductors of sound, and, of all materials, the most vibrative and conducive to melody. Cushions on the pulpit desk and the book boards of pews, and more especially drapery, absorb sound and tend to hinder its free passage: all curtains and hangings should therefore be abolished. A flat ceiling inpedes sound and a curved roof assists it. The lofty vaulted pointed roofs of many modern churches are also very objectionable in this respect; and the multiplicity of windows and perforations are a great defect. Opera boxes lined with wood are found practically excellent in assisting hearing. The hall of the French Chamber of deputies is stated to be one of the finest apartments in the world for the transmission of sound. The form was recommended, after much study and consideration, by a committee of architects. It is semicircular on plan, with a flat dome and plain walls.

We have now only to add that the chapel under description will accomodate 950 persons in the pews and free seats round galleries, including the space for children fronting the organ. Erected in accordance with the above general specification, the cost will average £ 3300, exclusive of the warming apparatus and gas fittings. This sum may of course be reduced by modifying or omitting the exterior decorations.

THE SUPPLY OF WATER.

The most natural supply of water is that in the shape of rain or dew. To these may be added tidal rivers, overflowing their banks, springs, or lines of natural drainage of water, the ocean and streams. Sources of artificial supply, as wells and indeed most of the above, although derived from natural sources, require generally some sort of preparation for use, as cleansing, filtering, etc.

The supply of water from rivers depends on the distance of the rivers and their levels above or below the surrounding land. For the irrigation of land they are not generally available unless nearly at its level, as mechanical power, involving much expense, is required to raise the water. When adopted for the supply of towns, channels or pipes are used to convey it to tanks

or reservoirs for the purpose of purification. If the towns are much above the level of the adjoining rivers, springs from higher lands, or the natural drainage of water from them, are adopted. A town close to a river is, however, best situated for a supply of water, as one on a lofty site is drained with more facility, there being no expense in raising refuse matters for manuring purposes, although it is difficult to procure sufficient surface water to flush the sewers without resource to an artificial supply. In Egypt, water from the Nile is collected in large reservoirs by means of leathern buckets, and a plug being removed from the bottom of the cistern the water is conveyed through rills and made to irrigate the land. In Bengal wells are dug, and the water is raised and carried through channels over the land. In China and Southern Africa the rivers and brooks are availed of and passages are formed with great labour to obtain that supply of water without which the ground would remain a sterile waste. "The irrigation by submersion is in Lombardy limited to rice fields. Elsewhere, as for instance in Tuscany, it is employed to improve the soil by the deposit of earthy matter from the water, whilst in France and Germany it is employed both for arable lands and meadows, leaving them under water till a scum appears which indicates that the crust of the soil begins to decay. The irrigation adopted in Lombardy for arable and pasture lands, as well as for meadows, is by filtration; for one could scarcely call submersion that very thin veil of moving water so skilfully spread over the land by the irrigators, who in this point are the best agriculturists in the world. The irrigation by regurgitation (more properly subterranean irrigation) is not in use in Lombardy; but in Switzerland, in the neighbourhood of Berne, and especially at Hofwyl, a considerable extent of land is irrigated in this manner with great success. The famous Fellenberg reclaimed the bogs of his Hofwyl estate by the application of subterraneous drains, so contrived that by stopping their mouths when the surface of the soil is too dry, he compels the water to swell back to the roots of the grass. This mode of irrigation is not only adopted to grassy lands after they have been drained, but to every other description of light soil, especially in hot climates. It was common in Persia long ago."

Aqueducts, so much employed by the Romans, are still occasionally used for the conveyance of water, and are in some instances found to be cheaper than pipes. The city of New York is supplied with water from the river Croton by an aqueduct thirty-eight miles in length. The chief arcade consists of fifteen arches, eight of which are 80 feet span, and seven fifty, the greatest height being 150 feet from the foundation. The work cost three millions stirling, and it is capable of discharging sixty million gallons of water in twenty-four hours. The distributing reservoir contains 21,000,000 gallons and the receiving reservoir 150,000,000. Cast iron pipes are found to be admirably adapted to convey water, and they are put together with socket ends. Water was formerly supplied in elm pipes, 6 or 7 inches diameter, with service pipes 3 inches. The iron mains are from 12 to 30 inches, the sub-mains 6 or 7 inches, and the service pipes 4 inches in diameter. A preparation of lime water in the interior tends to prevent corrosion. With reference to the expense of conveyance, one of the highest authorities, Mr. Hawkesley says that, "the cost of transmitting water to a distance of five miles, and to a height of 200 feet, including wear and tear of pumping machinery, fuel, labour, interest of capital invested in pipes, reservoirs, engines, etc., amounts to about $2\frac{1}{2}d$ per ton."

Rain water, from its softness, is exceedingly valuable. 32 inches, or according to Dalton, 31.3 is the mean depth falling annually in England. It is not however equally distributed. In Cumberland, at Keswick, the average depth in seven years was found to be 67 inches; at Plymouth 45 inches; and in the west part of Scotland 30 to 35 inches. All the water falling on the roofs of houses should be preserved, if not used for the purpose of clearing the drains. A roof containing 400 square feet, or 20 feet square, receives annually 4800 gallons. This is a large quantity, and, if in a large town, a filtering tank will render it extremely valuable for household use.

The comparison of these shows at once the absurdity of employing the same manufacturing process with every material. No 1 containing nearly double the quantity of the necessary solid compound of either of the other two. How, then, would it be possible without a knowledge of the composition of these different sorts of clay, to succeed in manufacturing from them articles of equal qualities?

It must always be borne in mind that silicates are essential and must be present to give hydraulicity, and that these silicates are formed during calcination. In the proper proportion of these and the lime in a caustic state, must be attributed the hydraulic character of the substance usually termed cement.

SCARFING AND JOINING TIMBERS.

(See Plate 3.)

PLATE 3, EXHIBITS SEVERAL METHODS OF SCARFING AND LENGTHENING.

Fig. 1. Is the plan of a lapped scarf which is drawn tight up to its abutments by hard wood wedges, and then bolted securely together.

Fig. 2. Is the plan of another method, with the addition of a small tenon lipped into each abutment.

Fig. 3. Is the plan of a plain scarf.

Fig. 4. Is the plan of a parallel scarf wedged and bolted.

Fig. 5. Supposing a tie beam be required forty feet in length, to be made from twenty feet planks, take six planks that will fit together close and even, let two be cut in halves, and two small three quarter inch joggles and tenons cut to each end, where the intersections meet or abut; place them together, having first traversed any irregularities away, so that they may be close to each other and also that the heading joints may break, and they will form when bolted together a strong beam forty feet long, by eleven inches by nine. The abutting ends must be driven up close before the bolt holes are bored, and all the bolt holes should be pared square with a mitre tool; the iron bolts must also be square except where tapped for the nut, so that there will be a square abutment between the iron and the wood, at every junction. (Fig. 6.)

Another method is explained in Fig. 7.

A Beam is required sixty feet long to be made from twenty feet planks twelve inches by three inches.

This will require twelve planks.

Cut one plank into two parts exactly in the middle, forming two planks ten feet long, twelve inches by three.

Cut two planks into two pieces, each at five feet from their ends, forming four pieces, or planks, two fifteen feet long, twelve inches by three inches, and two five feet long, twelve inches by three; the abutting ends to be joggled together by three quarter mortices and tenons, as before described.

The formation or plan will be as shewn in Fig. 7.

The first flitch will be

	5 feet,	20 feet,	20 feet,	15 feet.	*d.* = 60 feet.
The second		20 „	20 „	20 „	*c.* = 60 „
The third	10 „	20 „	20 „	10 „	*b.* = 60 „
The fourth	15 „	20 „	20 „	5 „	*a.* = 60 „

Thus the joints are broken so that no two come in contact.

The sides must be traversed straight and planed so that the whole may be close, and meet in every part; and if marine glue be applied to every joint before it is bolted, a beam of very great strength will be obtained.

Fig. 8 shews the heading joints of the flitch *a*.

Fig. 9 ditto ditto of the flitch *b*.

Fig. 10 gives the heading joints of the flitch *c*.

Fig. 11 ditto ditto same of the flitch *d*.

Fig. 12 is the plan of the beam, shewing the iron bolts.

This and the foregoing scarfed beams must be fixed with the heading joints in a vertical position; all the bolts to be of half-inch square iron, and the bolt holes pared square after boring. Timber ribs of different thicknesses have been more or less extensively used as ribs for arches since the time of Philibert de Lorme, a French architect; and we may hereafter take occasion further to enlarge on the subject.

PLATE 26,

EXHIBITS THE PLANS AND ELEVATION OF FOUR FOURTH-RATE HOUSES.

Each house comprises the following accomodation:

A front parlour . . . . 12′ „ 0″ × 11′ „ 6″
A back ditto . . . . 11′ „ 0″ × 9′ „ 6″

These two rooms communicate by means of folding doors.

A kitchen . . . . 12′ „ 0″ × 8′ „ 0″
A wash-house . . . . 8′ „ 0″ × 6′ „ 6′

Water closet and place for ashes.

There is to be a coal cellar under the staircase.

The upper floor consists of

A large front bed-room . . . . 12′ „ 9″ × 9′ „ 6″
Children's room adjoining . . . . 9′ „ 0″ × 5′ „ 0″
A back bed-room . . . . 11′ „ 0″ × 8′ „ 0″
Ditto over the kitchen . . . . 12′ „ 0″ × 8′ „ 0″

These houses, if built of stock bricks with cement dressings, fir timber, and slated roofs, may be erected and finished fit for habitation for £750. A single house, built independently of the others, could be executed in a similar manner for under £200. The internal fittings to be kept of course perfectly plain, and the kitchen and wash-house to be paved, the former with 3″ York, the latter with stock bricks laid flat on sand and jointed in mortar.

TWO SEMI-DETACHED FAMILY RESIDENCES.

PLATE 27,

Represents the plans and elevation of two semi-detached family cottage residences; they are also well adapted for small farm houses, by taking either plan from the party-wall; and the flank wall would form part of any farm or other erection that might be required, without any interference with the internal arrangement.

These cottages are proposed to be built of bricks, with stone-facings and quoins, or with cement dressings, or bricks of two colors; the roofs to be slated.

The large cottage contains an entrance-hall and passage, with a cellar under the stairs:

A living-room	16′ „ 6″ × 13′ „ 0″
A parlor	13′ „ 0″ × 11′ „ 0″
A bed-room or additional parlor	12′ „ 6″ × 9′ „ 6″
A kitchen	16′ „ 6″ × 10′ „ 0″
A scullery	16′ „ 6″ × 8′ „ 0″

Larder, coal cellar, and water-closet.

The height of this floor to be nine feet.

The upper floor contains five bed-rooms, very roomy; these are ten feet six inches in height, but are partly formed in the roof.

The smaller cottage contains

An entrance-hall and passage, with a cellar under the stairs:

A living room	15′ „ 0″ × 11′ „ 0″
A parlor	15′ „ 0″ × 14′ „ 6″
A kitchen	14′ „ 6″ × 10′ „ 0″
A scullery	15′ „ 0″ × 10′ „ 6″

Larder, coal cellar, and water-closet.

The height of this floor is nine feet.

The upper floor contains four large bed-rooms with large closets; and the height of the ceiling of the bed-rooms is ten feet six inches, but, as before, they are partly formed in the roof.

In this last-described cottage the kitchen is lighted by a large window over the fire-place.

If this be deemed objectionable, the fire-place can be in the angle of the room and the window on one side.

These very roomy and convenient dwellings are well adapted for families; and are suitable for two or more adjoining freehold allotments.

They may be erected of stock bricks with cement dressings for about £800.

TWO SEVEN-ROOM HOUSES.

PLATE 28,

Is the plan and elevation of two seven-room houses, adapted for two or more adjoining freehold allotments. They require a frontage of thirty feet each; the frontage being 22 feet, with a pathway or chaise-entrance 8 feet wide on either side.

These cottages may be built single by making the party-wall a flank wall.

They each contain an entrance-hall and passage	21′ „ 0″ × 5′ „ 0″
Front parlor	15′ „ 0″ × 13′ „ 0″
Back parlor	14′ „ 0″ × 12′ „ 0″

Water-closet, larder and cellar.

Kitchen	12′ „ 0″ × 10′ „ 0″
Wash-house	10′ „ 0″ × 9′ „ 0″

The upper-floor consists of

A front bed-room	14′ „ 0″ × 13′ „ 0″
A back bed-room	14′ „ 0″ × 12′ „ 0″
A small room over the passage	8′ „ 0″ × 6′ „ 0″
A bed-room over the kitchen	15′ „ 0″ × 10′ „ 0″

These two convenient cottage residences may be erected for the sum of £560.

STAIRCASES AND TRAP-DOORS.

In the erection of dwelling-houses of every class, one most important consideration is to provide the best, most ready, and safest mode of escape in case of Fire. One of the most ordinary methods consists in the formation of a small opening in the ceiling joists, to which is fitted a flap which, when removed, admits a passage to a trap-door opening on to the roof. This is called a trap-door; it is so, in fact, being generally placed in the worst possible situation for communication with the roof, at the top of the staircase, and has consequently been the cause of a vast destruction of human life.

In the event of fire the staircase generally becomes a chimney-vent, increasing the draught, and, from its attractive power, quickly filling with smoke and flame. To add also to the evil, the bolts of the trap-door are often difficult to be withdrawn, and, under such circumstances, its utility is lost.

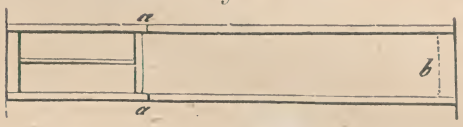
To avoid as much as possible these difficulties, particularly when life, or death, is dependent on prompt action during a few moments, put the trap-door in the attic, which can be easily cut off from the staircase by closing the door; and, the draught from below not having so immediate an action, the violence of the fire and the ascent of the smoke will be considerably diminished.*

The escape too would be much easier, for the inmates of the house are generally stifled with smoke before they can reach the place of exit; and if they are not stifled, they are so bewildered in one way or another, that they have little chance of saving their lives.

The approach to the trap-door is usually by a moveable step-ladder, which when wanted, may possibly be in the cellar, or elsewhere; the fastenings or hinges, twisted and stubbornly fast, present obstacles in many cases fatal. All these possibilities should be provided against, and a ready means of escape afforded, by one simple and simultáneous movement of the whole.

This may be accomplished (Fig. 1) by framing the ceiling joists of the most convenient attic-opening from the top-landing of the staircase, with two stout joists 10″ by 3″ to an opening nine feet long, and two feet wide, or of such length as may be required; this opening is to admit a step-ladder, hung by strong hinges, plates, and bolts, to the joist at *a a*, but working quite free; the other end at *b*, is secured in its place by a rope passing over a sheave, or large deep-grooved pulley in the roof, and fastened to a belaying pin, firmly fixed, within easy reach, to the wall or partition of the room below.

Fig. 1.



The back of the step-ladder may be covered with a thin sheet of zinc, and, when drawn to its place and fastened, the zinc will be flush with and form part of the ceiling.

Two iron plates, with studs, are to be screwed upon the upper edge of the sides of the step-ladder, about 18 inches from the top end or hanging part, to receive the eyes of the iron bar struts, which fasten the trap-door.

This will be better understood by the following diagrams.

* These improvements were submitted to the Board of Health and their adoption almost immediately recommended to the public.

Fig. 2.

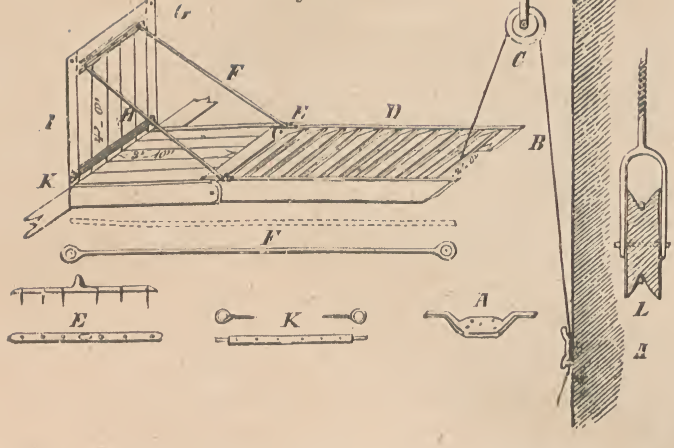


Fig. 2. Represents a trap-door closed, and secured by two iron bars, with loops and staples having free play at the top; the other end of the bars dropped on to the studs, screwed on each side of the steps, which are here represented as drawn up and flush with the ceiling; *A* is the belaying pin, around which the cord *B* is coiled; *C* is the pulley, screwed to a rafter, or otherwise secured in the roof. *D* is the step-ladder; *E* the iron stud plate; *F* iron rod bars; *G* the staples and eyes, to have free play; *H* the trap-door; *I* the door frame; *K* the hinge bar and staples; *L* enlarged section of the pulley and screw frame. It is evident, that, when the rope is loosened, the step-ladder will begin to fall, and, in so doing, the connection of the iron rods will gradually open the top end of the trap-door, see Fig. 3, B, until the ladder be about half-way down; at this point the iron rod will come in contact with the edge of the trimmer of the ceiling joists, see Fig. 3, *A*, which will tilt them off from the studs, and let the bars free. The trap-door will instantly fall by its own gravity and form a platform or floor, over which the person escaping may pass out to the roof. This is so simultaneous an action, that the trap-door and the step-ladder touch their extreme points of extent for service at the same moment, and the whole operation does not occupy more than a few seconds. The diagrams Fig. 3. 4. shew the whole ready for use, the trap-door open and down, the step-ladder in position, and the iron bars hanging loose.

Fig. 3.

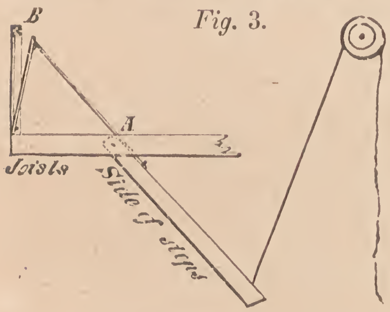
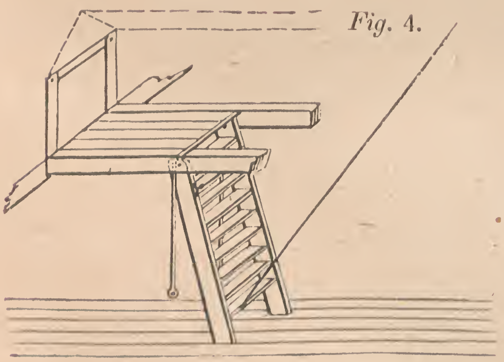


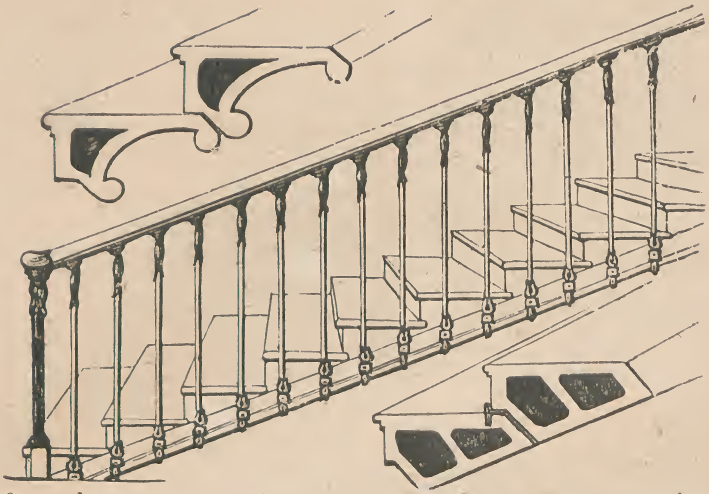
Fig. 4.



Great care must be taken in fixing this apparatus, that every part thereof should act together, and all work perfectly free; there must not be even the possibility of any catch or hitch in any one part.

Another method of securing staircases from destruction by fire is to carry up the well throughout with nine-inch walls, and to have the several doors opening into the well made double with thin sheet iron, with one and a half-inch air space between each sheet, and the whole representing a four or six-panel ordinary door. These doors must be closed every night, so that in whatever apartment the fire may chance to originate, the door would effectually confine it from the staircase, which in almost all cases becomes a stimulant to its ravages.

Fig. 5.



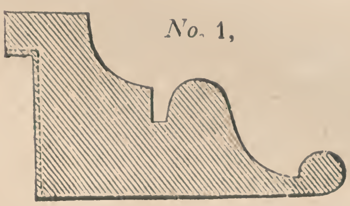
The stairs may also be carried up so as to be fire-proof, if erected with the hollow steps, lately introduced, made from clay, and burnt in the usual manner. See diagram Fig. 5. They are light, strong, sightly, and very economical, and being non-conductors of heat, and indestructible by fire, give greater chances of escape than the usual wood staircases. Constructed in this manner and with these simple and really economical precautions, the staircase may be kept almost intact from the ravages of the fire, while the combustible portion of the house is in danger of being destroyed. Under these circumstances, a means for the prevention of loss of life and property is preserved, which may be profitably turned to account.

PROFILES OF MOULDINGS FOR ARCHITRAVES, PANELS, ETC.

The following full-size diagrams will be found exceedingly useful to those who are not versed in practical details, as enabling them to choose for themselves the style of decoration they prefer for doors, windows, etc. The scale of prices will, of course, vary with the means at the command of the builder employed. The smaller mouldings vary from 1 d., to 2 d., per foot run, and the larger from 1 to 6 shillings per foot super.

The planing machines of the present day afford a vast variety of patterns of mouldings, but, should any new design be introduced, care must be taken that there is no undercutting on the face of the moulding, otherwise it must be worked by hand, which materially increases the expense.

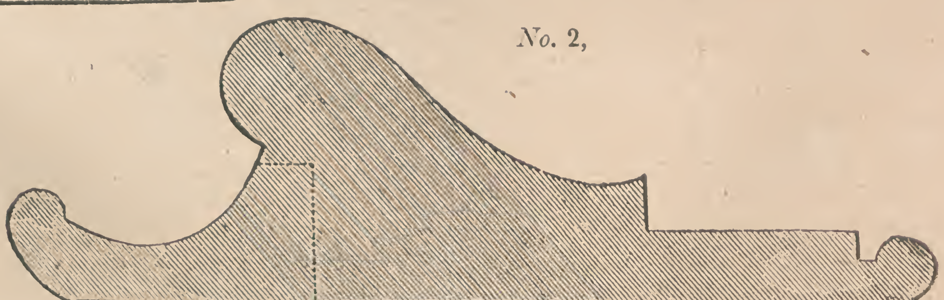
DESCRIPTION OF THE DIAGRAMS.



No. 1,

Exhibits a fillet, cove, quirk ogee and returned bead; it is adapted for a small architrave; or as a projecting moulding for outside door-panels. If used as an architrave, the side must be square.

No. 2,



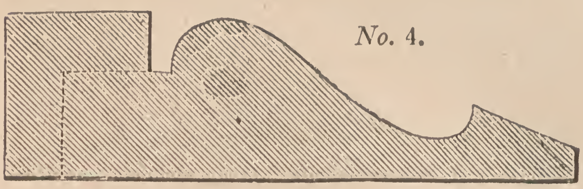
Exhibits an ovolo and bead, a cove, one half round and back ogee, square fillet, and

returned bead. It is adapted for an architrave, separated at the dotted line; the larger part forms a bold protecting moulding for large inside doors or gates; the smaller portion may be used for inside doors.

No. 3.

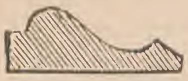
No. 3, represents a quirk ogee astragal and hollow; and is adapted for either an architrave or base moulding.

No. 4.

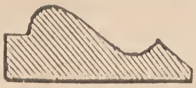


No. 4, is the Grecian ogee, and is likewise adapted for either architrave, or base.

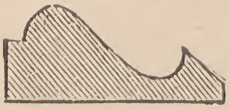
No. 5.



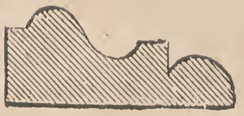
No. 6.



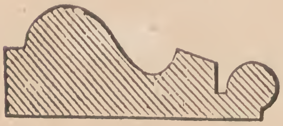
No. 7.



No. 8.



No. 9.

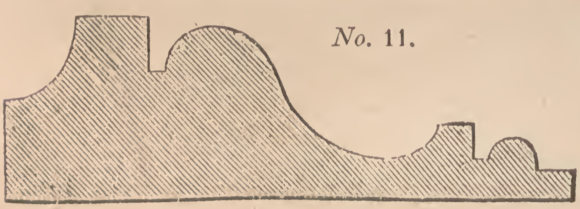


Nos. 5 to 9, are various mouldings for filling in the panels of internal doors.

No. 10.

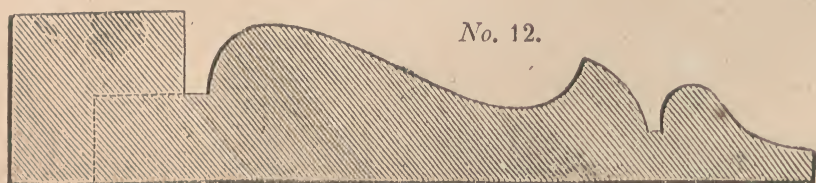
No. 10, represents a quirk ogee, fillet, and cove; this is also adapted for either architrave, or base.

No. 11.



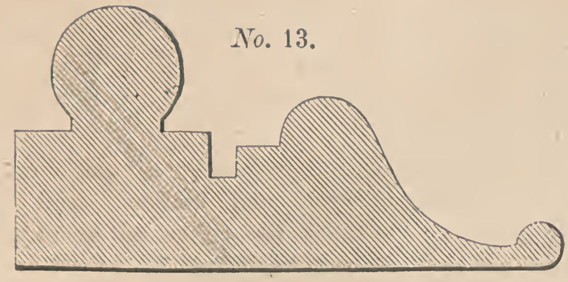
No. 11, exhibits a cove, quirk ogee, and astragal; and forms a very sightly architrave.

No. 12.



No. 12, exhibits the Grecian ogee, with ovolo finished with the common ogee; this will also form an architrave or base.

No. 13.



No. 13. Exhibits an architrave formed by the cock bead, and ogee and bead.

STRENGTH OF MATERIALS.

The following tables of the transverse strength of various materials or their resistance to pressure were determined by experiments on the various materials by Mr. Barlow.

Elastic strength of

	lbs.
Good English malleable iron	2050
Cast iron	2548
Teak	820
English oak	400
Best Canadian oak	588
Ash	675
Pitch pine	544
Red pine	447
Riga fir	376
Larch	280

It must be observed that the extreme strength is indicated by the above numbers. In practice not more than one-third or one-half of these weights must be applied.

To find the depth of an uniform beam the width, length of bearing, and weight to be supported, being given.

Rule. — Multiply the length, between the bearing in feet, by the weight in pounds, and half the tabular value by the breadth in inches. Divide the first product by the latter, and the square root of the quotient will give the depth in inches.

Example. Let it be required to find the depth of an uniform beam of oak to sustain a weight of 12,000 lbs. in the centre; the distance between the supports being 20 feet, the width of the beam to be nine inches. The strain to be one-half.

One-half tabular value 200
Width of beam 9
1800

12,000 weight in lbs.
20 distance in feet
240000 (133
1800
6000
5400
6000
5400
600

133 inches gives a square root of $11\frac{1}{2}$ inches, the depth of the beam.

To find the breadth of a beam, the depth, length of bearing, and weight to be supported being given.

Rule. — Multiply the length in feet, by the weight in pounds; divide the product by the tabular number multiplied by the square of the depth, and the quotient will be the width or breadth.

Example. Let it be required to find the breadth of a beam of oak to sustain 12,000 lbs.; the distance between the supports being 20 feet, and the depth of the beam $11^1/_2$ inches. The strain to be one-half.

Square of depth	133	12,000	weight in lbs.,
one-half Tab. value	200	20	distance in feet,
	26,600 :	240,000	(9 inches the breadth.
		239,400	
		. . . 600	

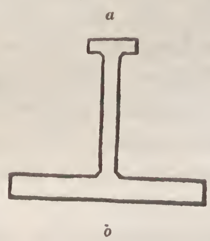
Therefore a beam of oak, 20 feet between its supports $11^1/_2'' \times 9''$ will bear a weight of 12,000 lbs. on its centre, calculated upon one-half its tabular value. When the load is distributed over the whole length of the beam, it will bear double the assumed load.

When a beam is fixed at one end only, and the weight is placed upon the other end as in the projection of balcony cantilevers, take only one fourth of the tabular number for a divisor.

Example. Required the depth for the cantilevers of a balcony of cast iron to project four feet, and to be placed 5 feet apart; the weight of the stone part 1,000 lbs., the breadth of the cantilever 2 inches, and the greatest load to be placed upon 5 feet of the balcony 2,200 lbs.

One-fourth of	3,200	lbs weight,
	4	feet length of cantilever,
Tab. number 637 :	12,800	(20-square root of which is 4.5 inches
	12,740	or $4^1/_2''$, the depth required.
	. . . 60	

Cast iron beams are sometimes introduced, and the following diagram is the section of one of the strongest forms yet obtained. It is the result of recent experiments for obtaining the strongest form of section for beams by Mr. Hodgkinson of Manchester. The top flange *a.* is $3'' \times 1''$; the bottom flange *b.* is $12'' \times 1^1/_2''$ or six times the area of the upper flange; the depth of the beam is 10 inches, and the bearing is twenty feet: the following is also Mr. Hodgkinson's rule for ascertaining the ultimate strength of beams of cast iron of the preceding section and proportion.



Multiply the sectional area of the bottom flange in inches by the depth of the beam in inches, and divide the product by the distance between the supports, also in inches, and 514 times the quotient will give the breaking weight in cwts.

Sectional area of bottom flange		18,0
Depth of beam		10
Length of beam inches	240 :	180,0 ($7^1/_2$
		168,0
		12,0

$$\begin{array}{r} 7^1/_2 \\ 514 \\ \hline 3598 \\ 257 \text{ Cwts.} \\ \hline 385{,}5 \\ \hline\hline \end{array}$$

To find the weight of cast iron beams or any quantity of cast iron, reduce the whole bulk into cubic inches, multiply the product by 27, cut off two figures to the right, the remainder is lbs.

If wrought iron let the multiplier be 28.

In lifting heavy weights care should be taken that the tackle is of sufficient power: the following rule for ascertaining the strength of ropes is very useful.

Rule. Square the girth, and divide the product by 5, the quotient gives the weight in tons that will break the rope.

DESIGN FOR A COTTAGE RESIDENCE.

The plates numbered 29 and 30 contain plans, elevations, and sections of a Cottage Residence.

The style adapted is that termed the "Old English," which was developed and prevailed in England during part of the fifteenth and sixteenth centuries. It is the mode of building which followed the old feudal castles, when the objects to be attained were comfort and elegance, instead of strength and power for defence. The large edifices, formerly called castles, were then denominated halls, and were characterized by many of the features introduced in our small example. Hargrave Hall, Suffolk, and Haddon Hall, Derbyshire, are specimens on a large scale to which we may refer the reader. The timber construction illustrated was very common during the sixteenth century. Ornamental external plastering or "pargetting" was also much used. "Some men wyll haue their wallys plastered, some pergetted, and whytlymed, some roughecaste, some pricked, some wrought with playster of Paris," is a quaint contemporaneous record. There are fine examples of inns at Glastonbury and Grantham, which are certainly more characteristic than the ordinary common-place and unpicturesque style now generally adopted for these houses. The ornamental chimney shafts, constructed of brickwork, were also very effective features. The barge-boards, first used in the fourteenth century, with the finials and pendants, produce a pleasing effect; and the bay-windows are as effective external as they are convenient internal features. These latter were retained until the reign of Elizabeth, whose name is given to a style which links the Old English with Italian architecture.

The Old English style is peculiarly suited to the class of domestic houses erected in the country. The broken lines of the roofs and gables, the varied projections of the different rooms, the rich chimney shafts and barge-boards, the picturesque bays and porches, the rustic covered spaces for shady seats, and the opportunities afforded for the introduction of various colours, by the use of brick, stone, and wood, all tend to produce a structure finely harmonizing with the surrounding scenery. When the roofs are sharply pointed, the chimneys lofty and effective, the windows varied, and the woodbine and other flowers are trained over the fronts, a most charming picture of rural comfort and elegance is produced. The building looks what it is, a cottage residence; and character and simplicity should always be aimed at.

The design given is proposed to be isolated; as, if built in the country, it is probable it

would be required in accordance with the quaint advice of Dr. Fuller, an old prebendary of Sarum:—"Country houses must be substantial, able to stand of themselves, not like city buildings, supported and flanked by those of their neighbours on each side." In towns, houses of this description are generally made semi-detached. The design will admit of this with a little modification;—the W. C. being placed under the staircase, the coal cellar in its place, and the window lighting the hall shifted over the first landing of the staircase. The two houses will then range conveniently side by side, the porches being contiguous.

DESCRIPTION OF THE DRAWINGS.

The building consists of two floors, and comprises the following amount of accommodation. On the ground floor, a porch, well-lighted hall and staircase, with store closet beneath the latter; two large parlors communicating by means of folding doors; and, with the windows commanding front and side views, forming cheerful and commodious apartments. A door opening out of the hall excludes the steam, etc., from the kitchen, which damages furniture, and, rising to the bed-rooms, damps and injures the linen. There is a large kitchen, with boiler, sink, and other requisites. The larder, coal cellar, and W. C. are all sufficiently separated and conveniently accessible. The covered space between the two latter will be found useful for many purposes; and under the similarly covered space at the side and in the porch, seats may be placed. There are three large bed-rooms on the upper floor, together with a small dressing-room, the comfort of which renders it almost an indispensable adjunct to the principal bed-room. The back bed-room may be divided into two rooms in the manner indicated on the plan. Two closets are provided for linen and stores.

SPECIFICATION of the materials to be used in the construction, and description of the manner of finishing and fitting up the house.

EXCAVATOR.

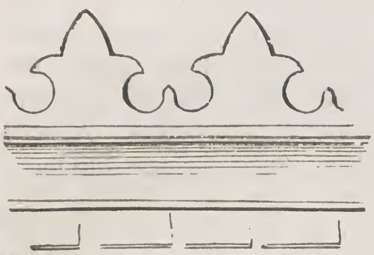
Dig out the ground to the depth and width necessary for the walls, drains, etc., and fill in, level and well ram the same as the work is brought up.

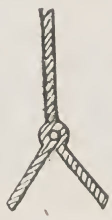
The concrete (if required) is to be composed of gravel and lime, in the proportion of one of lime to six of gravel. It is to be twice the width of the lowest course of footings, and averaging one foot in thickness.

BRICKLAYER AND TILER.

The walls are to be built of stock bricks, the whole of the facing to be of red bricks; no facing header to be cut in two, but the whole to be soundly bonded together, with as close beds and joints as possible. The bricks to be chamfered where shown, and neatly cut to stone quoins and the quartering on the face. The chimney shafts to be as indicated; those of ornamental brickwork may be procured ready manufactured of various heights and sizes. The whole of the facing is to be finished with a neat close flat joint. The flues to be $14'' \times 9''$, thoroughly pargetted and cored; in the ornamental shaft they are to be circular. Neatly cut slanting walls to take timbers of roof; bed all wall plates and lintels, and point the door and window frames; turn 9" arches over all openings, except where otherwise shown, and carefully cut the skewbacks. Leave small openings for air and ventilation where directed, and fill in the same with cast iron air brick. Set a copper in kitchen and build $4^1/_2$ walls to carry sink. Sleeper and fender walls on ground floor, and $^1/_2$ brick trimmers to fire-places on chamber level. Pave the coal cellar with stock bricks, bedded on dry ashes or rubbish, and pointed in mortar. A layer of gas-tar, mixed with sand, is to be laid over the surface of the walls a few inches above the ground level, to prevent damp rising. The mortar is to be composed of stone lime, mixed with clean sand, in the proportion of one of lime to three of sand.

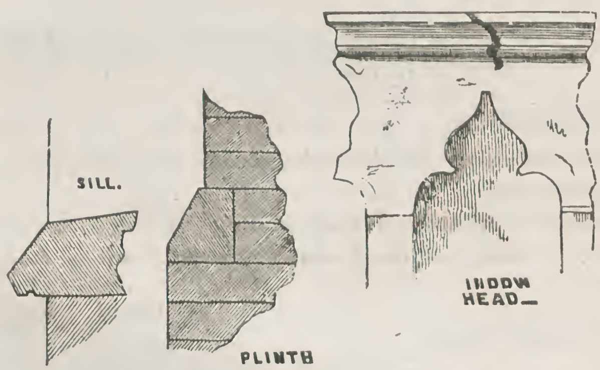
Stoneware tubular drains, jointed with well tempered clay, 4 ins. diameter to the W. C. and 3 ins. in all other cases; those to the sink and privy to be effectually trapped. The fall to be not less than 1 inch in 10 feet. If there is no sewer, a cesspool must be dug and steined in half-brick 4 feet clear diameter, and 10 feet deep, paved with half-brick, with 9″ dome over; an opening to be left in the same with stone cover and ring. Construct also a tank, 6 feet by 4 feet, and 5 feet deep, with 9 inch invert bottom and domed top; man-hole 2′ 3″ diameter with stone cover and flush ring; the whole to be built in cement, and the sides and bottom rendered with cement 1″ thick to ren er it perfectly water tight: the rain water pipes to be conducted into this. Sink a well 3 feet diameter, with half-brick steining and stone cover. Cover the roof with Staffordshire plain tiling of two colours, as shown, laid in patterns, and well torched with lime and hair, on double fir laths. Blue valley tiles bedded in lime and hair; ridge tiles moulded as shown, dowelled with stone at the joints, and with all requisite junctions and intersections at ridges, hips, etc.





MASON.

The quoins and dressing to the windows to be of lime stone, laid on its natural bed, neatly tooled and squared, the courses to be of irregular height and length, but to bond evenly with the brickwork. The heading and sill to the bay window and the plinth running round the building to be as shown in the margin. The steps to front entrance to be of Portland stone 11″ × 14″; the landing to be 3″ thick; the whole properly rubbed on the face, back jointed and set. The step to back entrance, W. C. and coal cellar to be of tooled York 13″ × 7″, 12″ longer than opening, back rebated and mortised for door post. Pave the kitchen, passage, and pantry with $2^1/_2$″ rubbed York, jointed in mortar, and laid on a bed of concrete ashes, or dry rubbish. well rammed. Sink-stone 7″ thick and 5 deep, perforated and rebated for 4″ bell trap, and set in mortar on the walls. The sills to the windows to be splayed and properly rubbed. 2 inch rubbed Portland slabs to the fireplaces, and tooled York inner hearths; the slab to the kitchen to be of rubbed York; and all to be 1 foot longer than opening, and 1′ 6″ wide. The chimney pieces to parlors will be selected; that to the kitchen to be of rubbed York, and the remainder of rubbed Portland, chamfered as shown.



CARPENTER AND JOINER.

The yellow fir to be of the best description of Memel; the oak of English growth, and the deals Archangel or Petersburgh, all perfectly sound and well seasoned. The carpenter is to assist the bricklayer in fixing the timber framing in the walls, it being previously worked fair on the face.

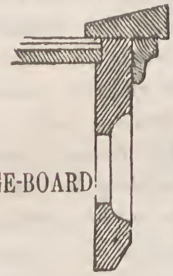
The whole of the timbers are to be of the scantlings, and put together in the manner shown on the drawings and herein described. The quarters, joists, and rafters to be not more than 14″ from centre to centre; lintels 18″ longer than the openings and $4^1/_2$″ deep;

no timber to be placed within $4^{1}/_{2}''$ of any flue, and all wood-work where seen, must be wrought. Insert fir bricks $4'' \times 2^{3}/_{4}''$, where necessary to doors, windows, etc.; and wherever the bearing of joists exceeds 10 feet, a row of herring bone strutting should be provided. The partitions are to be framed and put together with heads and sills $4'' \times 3''$, posts $4'' \times 4''$, and quarters $4'' \times 2''$. Lintels at bay as shown.

ROOF.

The roof is to be framed in the manner indicated and with timbers of the following scantlings.

Rafters and Collars halved into one another, and firmly pinned	$7'' \times 2^{1}/_{2}''$
Plates in all cases of one length and well-lapped and spiked	$4'' \times 4''$
Ridge and Valley pieces	$9'' \times 1^{1}/_{2}''$
Rafters to dormers	$6'' \times 2^{1}/_{2}''$
The lean-to roofs over Bay W. C., coal cellar and covered space, to have rafters	$5'' \times 2^{1}/_{2}''$
Ridge plates secured to the wall by iron brackets . .	$5'' \times 2^{1}/_{2}''$
Lower plates	$4'' \times 3''$


BARGE-BOARD

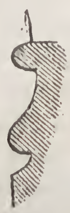
The barge-boards are to stand out from the wall one foot, and to be firmly secured to the projecting ridge and plate at top and bottom; they are to be of the section shown in the margin, 2 inches in thickness: inch wrought boarding is to cover the projecting space, and the capping should be of oak, weathered and throated. Fix at apex an ornamental finial and pendant, of the profile indicated: the finials and barge-boards to dormer windows are to be of the same profile and section, but smaller.

FLOORS.

The joists on ground floor are to be $5'' \times 2^{1}/_{2}''$ with oak plates $4'' \times 3^{1}/_{2}''$. Those on chamber floor, to be $10'' \times 2^{1}/_{2}''$; trimmers and trimming, joists $10'' \times 3''$; the joists to passage $7'' \times 2^{1}/_{2}''$; plates $4'' \times 3''$.

The parlors and hall to be covered with inch yellow deal straight joint flooring, with splayed heading joints and mitred borders to slabs; the kitchen, passage, larder, and W. C. to have inch yellow deal folding floors; and the bed-room floor to be laid with inch yellow deal straight, joint floors, with mitred borders to slabs.

SKIRTINGS.



Inch sunk and moulded skirting 13″ wide to parlors; inch chamfered skirting 10 wide to hall, and inch square skirting to kitchen and offices 6″ high. The two principal bed-rooms and the dressing room and landing to have skirting as in hall; the remainder to be square 6″ high.

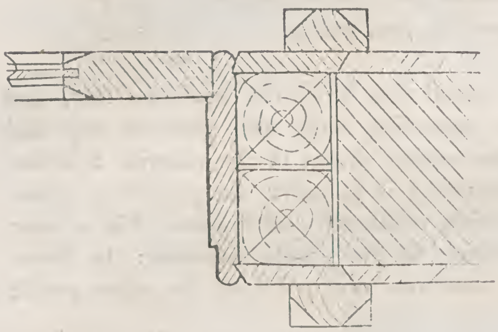
THE STAIRCASE.

To have inch $^{1}/_{4}$ yellow deal treads, and quarter spaces with moulded and returned nosings, glued, blocked, tongued, and bracketted for plastering, on strong fir carriages. Inch $^{1}/_{4}$ moulded string, ramped and kneed, so as to be one uniform height above the nosings, and into which the steps are to be housed and well wedged up in glue; inch $^{1}/_{4}$ cut, sunk and beaded string boards, and $^{3}/_{4}$ beaded linings to landing; inch torus skirting, with narrow grounds, on quarter spaces. The hand-rail to be of Honduras mahogany $4'' \times 3''$, wreathed, ramped, and moulded, with mitred and turned caps to 3″ turned newels. Inch wainscot, dovetailed square bar balusters two to each step; six to be of wrought iron, with plates at top and bottom, to secure them to handrail and steps. Inch $^{1}/_{2}$ square partition under stairs.

DOORS.

The front entrance door to be $2^1/_2''$ deal, wrought framed, ledged and braced, covered with inch, ploughed, tongued, and chamfered jointed battens, hung to rebated and splayed frames $4^1/_2'' \times 4''$, with wrought iron ornamental strap hinges, 2′ „ 4″ long, secured with wrought iron latch and ornamental drop ring; 10″ spring stock lock, iron escutcheons and barrel bolts. Inch oak step and riser rounded.

The back entrance door to be of deal, 2″ thick cross-boarded and beaded, hung to fir proper door case on $4^1/_2''$ wrought butts; thumb latch, 9 stock lock and 9″ bolts; the frame let into step. The doors to W. C. and coal cellar, to be $1^1/_2''$ ledged and braced doors filled in with $^3/_4''$ beaded boarding, and hung on 4″ bufts to wrought proper door cases $4' \times 4''$: a stock lock to be provided for cellar door; that to W. C. to have a thumb-latch and small bolt.

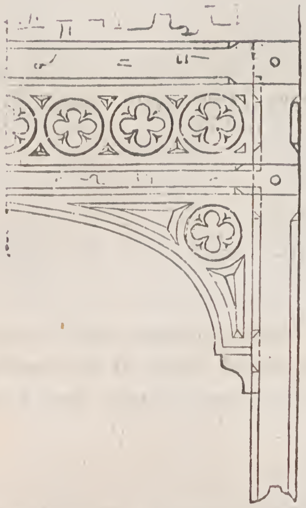


The parlor doors to be of deal 2″ thick, stop chamfered square framed, hung on $3^1/_2''$ brass butts to inch $^1/_4$ double rebated and rounded linings; inch framed grounds 5″ wide with chamfered architraves as shown in the margin; each door to have a 6″ three-bolt mortice lock, ebony knobs and furniture. The doors communicating between the two to be hung folding. The hall door to be similar to the others, with architrave towards hall only. The kitchen closet and larder doors to be $1^1/_2''$ square framed; hung on 3″ butts to $1^1/_4''$ rounded linings; with iron rim lock; that into larder to be framed as a sash door, and the lower panels pierced with holes to assist the ventilation. The two principal bed-rooms, the dressing room and closet, to have doors and finishings similar to parlors; to be hung on 3″ butts, with similar locks and ebony handles, but no finger plates; the closet door to be $1^1/_2''$ thick; with 4″ good closet lock. The opening on quarter space to have no door, but architrave and lining as just described. The remaining doors to be $1^1/_2''$ square framed, hung on 3″ butts to inch rounded linings, with 6″ iron rim locks.

WINDOWS.

The windows to parlors, hall, kitchen, bed-rooms, and dressing room to be all moulded casements of inch $^1/_2$ deal, with heads as respectively shown, hung on $2^1/_2''$ butts to wrought rebated and beaded frames $4'' \times 3''$, with oak sunk and weathered sills, and galvanized iron weather bars, with drips formed under the casements: each light to be secured by means of a brass fastening with hinged joint and brass knob; the kitchen and back bed-room windows to have iron crank fastenings, and all to have proper stayhooks 9″ long, with eyes fixed to the casements. The parlor windows to have lifting shutters of inch $^1/_2$ deal, stop chamfered and square framed. Cased frames: inch outside and inside linings; inch $^1/_2$ heads, and inch $^1/_4$ wainscot pulley pieces, with all necessary parting beads, and $^7/_8''$ inside and outside beads returned on top; patent lines, brass axle pullies, cast iron weights, and inch rounded flap, hung on 2″ brass butts. Inch $^1/_4$ stop chamfered square-framed window backs; the kitchen window to have similar shutters and window back, the chamfer omitted. The shutters to be omitted on chamber floor and to hall window; the windows, being finished with $^3/_4''$ rounded window boards, linings and soffits. The remaining small windows are to have $1^1/_4''$ chamfered casement sashes hung on 2″ butts to frames similar to the others, $4'' \times 3''$, with oak sills, etc., as before, and fastened with small bolts; $^3/_4''$ rounded window boards, linings and soffits.

PORCH.



The timber work to the porch is to be framed and put together in the manner indicated. Wrought and stop chamfered posts 12″ square, let into stone plinth, the upper parts securely framed into it, and all firmly put together. The panelling at top and sides to be out of 2″ stuff, chamfered, and let into groves formed in posts and cross-pieces; the side to be framed in two divisions, with arched heads and quarter-foils over, as in front. The covered space at side to be as indicated, with posts 6″ square, head 9″ $\times$ $3^1/_2$″; head carrying rafters of the same scantling as described over out-building.

THE WATER-CLOSET is to have $1^1/_4$″ deal beaded frames, mortised and clamped flap, hung with $2^1/_2$″ butts on fir proper framed bearers and grounds; $^3/_4$″ small skirting round three sides of seat. A cistern 4′ 0″ $\times$ 2′ 6″ $\times$ 2′ 0″ deep is to be fitted up over W. C. carried on proper bearers; 2″ tongued bottom and $1^1/_2$″ sides, with $^1/_2$ inch iron bolt, nuts and screws complete. A dresser is to be fitted up complete, with drawers shelves, etc., of the size shown; and shelves to be also fixed in the larder, as desired; an inch beaded bell board 11″ wide in passage adjoining kitchen; beaded rails for dish covers, a plate rack, cover for copper, and all other incidental fittings.

PLASTERER.

The plastering to be executed with well burnt chalk lime, incorporated with clean sharp sand and strong hair, every care being taken to prevent blistering and other defects; the laths to be strong lath and half laths. The internal walls and partitions to be rendered (the partitions lathed), floated and set for paper, and the ceilings whited: the kitchen, larder, and coal cellar to be twice limewhited. Angle staves to all projecting angles. 9″ Cornices to parlors and hall.

PAINTER.

The whole of the external wood and ironwork to be painted 4 times, and finished with good common colours: the exterior woodwork finished dark oak; and that to hall and parlors grained wainscot and twice varnished in best copal; the handrail and newels to be French polished.

PLUMBER.

The water being presumed not to be laid on, a 3″ brass force pump is to be fixed in the kitchen, with inch $^1/_2$ suction pipe from the well. The water is to be forced to the cistern over W. C. through an inch $^1/_4$ pipe, and from the top of the cistern an $^1/_2$″ notice pipe is to be brought back to sink: line the cistern with 7 pounds lead, nailed over the edges. Inch $^1/_4$ waste pipe, $^3/_4$ service, and 4″ lead soil pipe delivering into drain. $2^1/_2$ waste pipe from sink, and 4″ brass grate and bell trap. The W. C. to be fitted with white ware basin, and best made closet apparatus, with every requisite complete. A $2^1/_2$″ cast iron pump must be fixed where convenient, with $1^1/_4$ suction pipe from rain water tank.

SMITH.

$4^1/_2$″ Moulded eave gatters, properly secured, and 3″ rain-water pipes; with heads of a Gothic pattern; the ends of the pipes to be connected with the drains. Wrought iron chimney

bars $2^1/_2'' \times {}^1/_2''$ 18″, longer than openings, turned up into brickwork. Provide stove to copper: the remainder to be chosen.

GLAZIER.

The windows to be glazed with the best double crown glass; those to the kitchen offices and the small windows to have second crown glass. The sash door to have 21 oz. sheet glass, fixed with a bead.

PAPER HANGER.

The papers will be chosen, and a price to be then named for hanging them.

BELL HANGER.

Each of the parlors to have two sunk pulls, and two of the bed-rooms one each, to correspond with the furniture of the doors. The wires are to be conveyed down to the flooring in zinc tubing, and conducted to the kitchen passage; each bell to have a small neat brass pendulum.

COST OF CONSTRUCTION.

It is always difficult to give an accurate estimate of the cost of buildings. The prices of materials and the value of labor are continually fluctuating, and works are executed at very different rates in various parts of the country; the prices also greatly depend on the facilities builders have at their command, some being enabled to execute commissions much cheaper than others. Although we have specified certain materials, these will be varied according to the ease or difficulty of procuring them; that which is most expensive in one place being cheapest in another: and we shall therefore vary the specifications of our designs. If carried out in accordance with the description above given, the house may be erected in the home counties for about £480. Of course, if the amount of exterior decoration is reduced, the figures will stand proportionately lower; and if cottages are built in pairs, a still further reduction may be made, on account of one party wall serving for the two, thus allowing of a deduction to the extent of one divisional wall. If let at £30 per annum, a return of 6 per cent will be obtained on the sum expended. Against this must be set the ground rent (if any), taxes, and the contingencies arising from loss of tenant, repairs, etc.

WORKMEN'S COTTAGES.

See Plate 31.

This plate comprises an elevation, section, ground and upper-floor plans for a pair of workmen's cottages; also an elevation for a Row of Cottages of similar construction.

The cottages are proposed to be built in flats. A passage divides the two cottages on the ground floors, and, by means of two porches and two stone or wood staircases, affords separate entrances to the above dwellings. Thus all the comforts of separate residences are secured to the inmates, at a considerable less cost of construction than if the residences were completely separated: the same roof and foundation serving for all.

The ground floors are entered through porches on each side of the entrance-passage by doors opening in each cottage into a living room, communicating with a bed-room; a

scullery is fitted with wash-house, copper and sink, and a pantry adjoining. At the end of the passage, on each side, are placed the water-closets appropriated to the ground flats.

The ascent to the upper flats is by stone or wood stairs at the end of the central passage. On the landing are placed the upper water-closets, and opposite to them are glass doors opening into and lighting the upper sculleries; these may be further lighted by other half glass doors, communicating with the living rooms. The upper principal bed-rooms are placed over the lower ones, and are of the same size. The upper living-rooms also communicate each with a child's bed-room in the front of the cottages: these may be used for pantries if preferred.

It is evident that these dwellings are intended only for very small families, and such residences are required in all large manufacturing towns.

The pair of cottages will cost in the erection about £300 or £350, according to the price of materials and labour in the neighbourhood; and at 3*s* per week for each flat they would produce £31 „ 4*s* per annum.

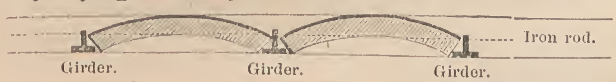
DIMENSIONS
OF THE GROUND FLATS.

Passage	23′ × 3′ 6″
Porch	5′ × 3′ 6″
Living-room	11′ × 11′ —
Bed-room	11′ × 9′ —
Scullery	7′ × 5′ —
Pantry	5′ × 3′ 6″
Water-closet	4′ × 2′ 8″

UPPER FLATS.

Water-closets	4′ 6″ × 2′ 6″
Living-room	11′ — × 11′ —
Bed-room	11′ — × 9′ —
Scullery	7′ — × 9′ —
Child's bed-room	7′ — × 7′ —

These cottages may be constructed of red bricks with white brick or compo dressings: or they may be built of rubble stone work, free-stone dressings, and internal brick partitions. The upper floors may be rendered fire-proof by laying them upon brick arches turned between iron girders, as shown in the annexed diagram.



In the elevation for the row, the small windows lighting the porches have been omitted. This will be optional with the builder, as light will always be afforded by the open entrance passage.

The roofs will be constructed of ceiling joists tying the rafters, purlins, and struts, or collar beams, ridge, and valley pieces.*

ARCHES.

An arch is an arrangement of bricks, stones, or other materials in a curved form. The wedge-shaped stones used for this purpose are called *voussoirs;* and the centre stone a key stone; the upper surface or edge of the voussoirs, or bricks, forms what is called the *extrados* of the arch, and the lower edge the *intrados* or soffite. In a well formed arch the mutual pressure of the stones or bricks of which it is composed, enables it to support superincumbent weights; and for this reason it is essential that arches should be introduced over all openings,

* For description of Plate 32 see page 16; and for Plates 33, 34 see page 21.

both in stone and brick walls, internally as well as externally. For the construction of internal counter or discharging arches, see Fig. 2, Plate 9. Inverted arches are placed under wide openings to equalize the weight; see Fig. 3, Plate 9. The portion of the wall on which the springing of the arch rests is called the *pier* or *abutment*.

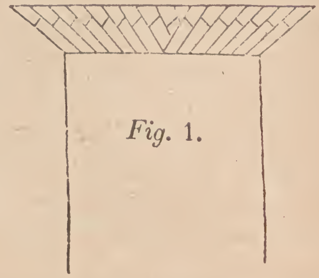
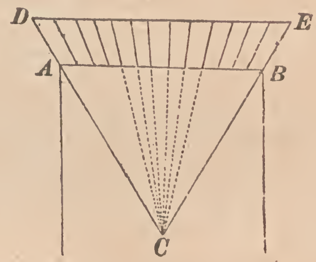


Fig. 1.

The pressure on the bricks or stones of which the arch is composed, increases from the crown or uppermost part of the arch to the springing or extremities, resting on the pier or abutment on which the weight is discharged. Arches receive their names from the nature of the curves of their intrados or inner edge; as circular, elliptic, parabolic, etc. Sometimes they are named after the style of Architecture: as Gothic, Roman, etc. There are also what are termed, by an abuse of names, flat-arches. The use of the camber-slip however shows that this mode of construction partakes but slightly of the form of the arch. The camber-slip is a piece of wood with at least one curved edge, rising 1 inch in 6 feet, for drawing the soffit lines of camber or straight arches. The other edge is sometimes curved about half an inch in 6 feet, for the purpose of drawing the upper side of the arch, so as to prevent it from becoming hollow by the settling of the bricks. The upper edge of the arch is not always cambered but is sometimes left straight. When the bricklayer has drawn his arch he gives the camber-slip, which is sufficiently long to answer many different widths, to the carpenter to form the centering used to support the arch during construction.

An egregious fault in the construction of flat-arches is not giving them a sufficient skew-back. The proper proportion of a skew-back is one third more than the height of the arch; thus a nine inch arch requires twelve inches skew-back; a twelve inch arch, sixteen; and a fifteen inch arch, twenty inches. The centre of skewing for camber arches may be thus found.



On the set line *A B*, in the annexed figure, describe an equilateral triangle *A B C*. Prolong *A*, and *B*, to *D*, and *E*, which gives the skew-backs *A D*, and *B E*; which in this instance will be 16 inches each, the height of the arch being 12 inches. All the other joints may be drawn by prolonging them to the point *C*.

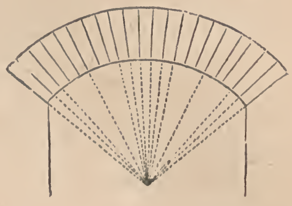
The arch should consist of an odd number of bricks, that it may have a proper bond, and the key stone be placed in the middle of the arch.

It is evident that the proper construction of these arches requires that the bricks be carefully guaged. This is performed by rubbing them to a proper shape, so that, when laid, the joints may be perfectly even and close in every part. Bricklayers often save themselves the trouble of rubbing the bricks, and form an imperfect skew-back by laying the bricks with the joints open at the upper end. In this case the whole strength of the arch depends on the adhesive quality of the mortar. The best mortar for turning arches is that made from the blue Lias lime stone, or some other moderately hydraulic stone. Cement sets too quickly, and does not allow the arch time to adjust itself to its burden.

But perhaps the most faulty method of constructing straight arches is that exhibited in the accompanying diagram Fig. 1, in which the bricks have their longer sides parallel and the arrangement of the bricks exhibiting none of the properties of an arch. Yet this malformation is constantly practised at the present day, when the defects of the brickwork are destined to be covered by an external coat of cement, and it is the fruitful cause of the fractures which abound in elevations that are thus covered. These arches are called French arches.

Straight arches, if properly constructed, answer the purpose very well of covering narrow openings in brickwork, where the superincumbent weight is not very great; but in large buildings, and especially in the lower stories, it is advisable to introduce segmental, semi-elliptic, or semi-circular arches.

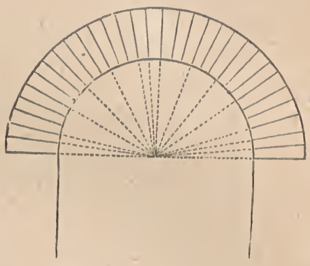
Fig. 1.



A segmental, or scheme arch, is contained between two concentre circles and the springing lines, which are portions of the radii of those circles thus: see figure 1.

A semi-circular arch is formed in a similar manner, see figure 2.

Fig. 2.



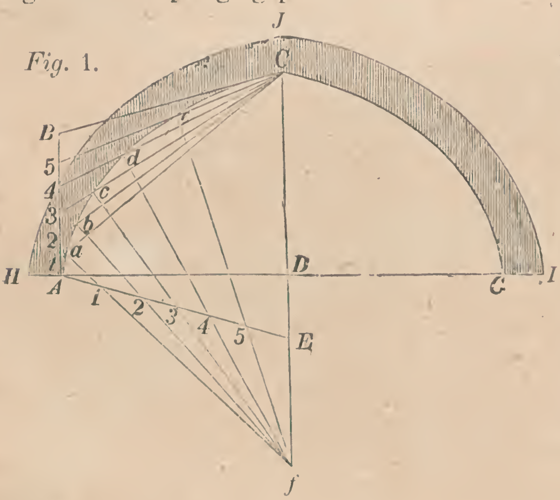
The method of describing semi-eliptic arches is as follows. Let *A B* be the span of the arch, and *C D* its height; from the middle of *A B*, and perpendicular thereto, draw *A X*, and *D X*, respectively parallel to *C D*, and *A C*, and divide *A X*, and *A C*, each into three equal parts, by the two intermediate points 1, 2. Make *C Z*, equal to *C D*, and from the points 1, 2, in *A X*, draw straight lines to the point *D*, intersecting straight lines drawn from the points 1, 2, in *A C*, to the points *y* and *n*. Make the angle *D n h* equal to the angle *n D C*, and prolong *D C* to meet *n h* in *h*. Join *y n*, or suppose *y n* to be joined, and bisect *y n* by a perpendicular, meeting *n h* in *i*. Join *y i*, intersecting *A B* in *k*, and let *n h* inter-

sect $A\ B$ in l. In $C\ B$, make $C\ r$ equal to $C\ l$, and from h, through r, draw $h\ u$. In $h\ r$, make $h\ q$ equal to $h\ i$, and in $C\ B$, make $C\ s$ equal to $C\ k$. Join $q\ s$, and prolong $q\ s$ to t. From the centre h, with the radius $h\ D$, describe the arc $n\ u$, and from the centres i and q, describe the arcs $n\ y$ and $u\ t$, and from the centres k and s describe the arcs $y\ A$ and $t\ B$. Then will $A\ y\ n\ D\ u\ t\ B$ be the intrados of the arch. Prolong the lines $i\ y$, and $i\ n$; $q\ u$, and $q\ t$, as also $C\ A$, $C\ B$, to E, o, p, w, v, F, and make $D\ G$ equal to the breadth of the arch; then by the same centres, h, i, q, k, s describe the extrados $E\ o\ p$, $G\ w\ v\ F$, which will complete the right section of the arch. The joints of the bricks are drawn through the same centres, observing that the extrados must be divided into parts each equal to the thickness of a brick.

GOTHIC ARCHES.

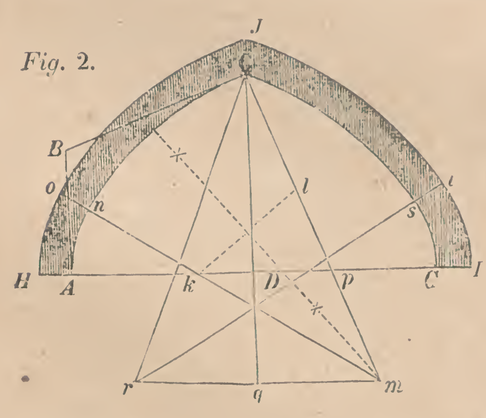
Let $A\ G$ in the following figure be the span of an arch, and $D\ C$ the perpendicular height from D, and let $C\ B$ be a tangent to the arch at the summit C, and $A\ B$ perpendicular to $A\ G$, a tangent at the springing point A.

Fig. 1.



To describe a Gothic arch by finding any number of points in the curve: — Prolong $C\ D$ to f, and in $D\ f$ make $D\ E$ equal to the difference between the two perpendiculars, $A\ B$ and $D\ C$. Join $A\ E$ and divide $A\ E$ and $A\ B$ each into the same number of equal parts. In this example each of these lines is divided into six equal parts. Through the points 1, 2, 3, etc. in $A\ B$, draw straight lines to the point C, and from the point f, through the points 1, 2, 3, etc. in $A\ E$, draw right lines, to intersect the former right lines, in the points a, b, c, etc. Through these points draw the curve $A\ a\ b\ c\ d\ e\ C$, which will form, one half of the section of the intrados of the arch. In the same manner the other half of the intrados may be constructed. The extrados lines, $H\ J$ and $I\ J$, are found by drawing them at an equal distance from the intrados lines $A\ C$ and $G\ C$.

Fig. 2.



To describe a Gothic arch by centres. See *Fig.* 2. Draw $C\ m$ perpendicular to $C\ B$, and in the span $A\ G$, make $A\ k$ equal to $A\ B$. In $C\ m$, make $C\ l$ equal $A\ k$ or $A\ B$, and join $k\ l$. Bisect $k\ l$ by a perpendicular, meeting $C\ m$ in m, and join $m\ k$. Prolong $m\ k$ to n. From the point m, as a centre, with the distance $m\ C$, as a radius, describe the arc $C\ n$, and from the centre k, with the distance $k\ n$, describe the arc $n\ A$. Then $A\ n\ C$ will be half of the curve of the section of the intrados. Prolong $A\ G$ to H and I, and prolong $k\ n$ to o. Make $A\ H$ equal to the breadth of the course which forms the head of the arch; then again from the centre k, with the radius $k\ H$, describe the arc $H\ o$, and from the centre m, with the radius $m\ o$, describe the arc $o\ J$, meeting the summit in the point J. In the same manner may be found the extrados of the other half of the right section of the arch.

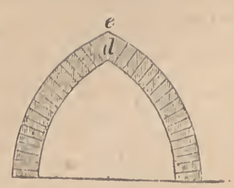
But the centres may be more readily found by the following construction, by observing that the centres must be in a symmetrical position on each side of the right line $C D$, which divides the right section into two symmetrical parts. Make $D p$ equal to $D k$, and prolong $C D$ to q. Draw $m r$ parallel to $G A$, intersecting $G D$ prolonged in q, and make $q r$ equal to $q m$. Join $r p$ and prolong $r p$ to s. Join $r C$ from the centre r, then with the distance $r C$, describe the arc $C s$, and from the centre p, with the radius $p s$, describe the arc $s G$. Again making $G I$ equal to $A H$, from the centre p, with the radius $q I$, describe the arc $I t$, meeting $p s$ prolonged in the point t; and from the centre r, with the radius $r t$, describe the arc $t I$; and thus we have described the whole of the right section of the arch.

Bartholomew, speaking of the excellence of Gothic Arches, says "a great deal has been written relative to the strength of different kinds of arches; but it seems that from the fall of pointed architecture till very lately, we have lost sight of the principle, that *that which is practically the strongest and most convenient, is practically the best.*"

"These properties are possessed in an eminent degree by Gothic Arches; for they will subsist firmly, of a construction much lighter, and containing a much less quantity of materials than any other kind; the most ignorant may learn this without acquiring scientific knowledge: all other arches require to be complete, or they will be liable to fall; but aspiring pointed arches, containing no materials which are really hanging in a state of jeopardy from downward pressure, have less tendency then any other kind of arches to thrust out their abutments and derange their haunches; for having no horizontal crowns to fall down, they are destitute of that outwardly wedging property which causes the ruin of other arches, and that of the piers beneath them."

"The stones composing the lofty ancient pointed arch, *even without cement, would scarcely slide from their plans*, hence we see, that although violent destruction has come to an infinite number of the finest buildings in the pointed style, in numerous instances, *the whole side of their arches remain perfect even up to their very points, notwithstanding their other halves have been destroyed and three centuries of rain, thaw, frost, and storm have preyed upon them;* while almost half the number of *our modern arches*, though possessing all their parts, *are a complication of fracture*, and need but some slight accident to remove a small portion to cause them to fall to utter ruin."

"Some of those who write upon the equilibrium of arches assert that over each abutment of a semi-circular arch a load of infinite altitude is required, in order to counter-balance the key-stone and other parts of the arch, which from their downward pressure are in jeopardy, and tend to thrust away the abutments intended to confine them; but as such an altitude would be neither convenient nor possible, and as great weight added to the abutments would make them sink into the earth and thus ruin the arch, some have imagined that to omit the lower parts of the arch and to make it only a segment of a circle, with no part of the arch deeper than from b to c, is to omit that portion of it which it is neither convenient nor even possible to load sufficiently to resist the outwardly wedging property of the upper voussoirs. But however this subject may be involved in obscurity, and however little may, from the want of actual experiment, be known relative to it, yet it is certain that a very considerable portion of the whole weight of a circular or segmental arch is thrusting away the abutments, whereas a high pointed arch not having its voussoirs carried up beyond d d, there are no materials at e in jeopardy with a direct downward pressure; so that the Gothic architects,



omitting all the dangerous parts of an arch, shewed a kindlier and more refined acquaintance with practical science, than those who have written the most ingenious and abstract theories upon the equilibrium of arches, and who, instead of seeking to reduce the quantity of materials in jeopardy, have only sought to burthen, at an enormous expence of solid masonry, the extrados and piers of the arch in a manner, which, in cases of doubtful foundations, might grind the whole work into the earth."

DESIGNS FOR A PAIR OF MODEL COTTAGES.

FOR LABOURERS, MECHANICS, AND OTHERS

(See Plate 35. 36.)

We have no doubt that the majority, if not the whole of our readers, will heartily re-echo the sentiment, that, considering the importance of the labouring population, — they form in fact the nucleus and stamina of the nation, — too much consideration can hardly be given to the amelioration, by proper and efficient construction, of their cottage houses. The rich can take care of themselves: the poor must be cared for by the rich. Their true interest it is to do so; for whence come all contagious disorders, — the cholera and the fever that periodically desolate the land. Their rise may be traced to the unventilated dwelling, the choked-up drain, the stagnant decaying heaps of refuse contaminating the air, in the overcrowded dwellings of the lower classes. And thence come other evils. The contrast between these wretched hovels and the stately mansions of the rich forces itself on the minds of the poor; and naturally, indeed, may they feel exasperated against those who appear to have so little regard for their position. Educate and refine them you may strive to do, but worse than useless will be the attempt unless the commencement of such efforts be founded on making them happy in their homes. With such uncultivated minds, material comfort must be set before mental discipline; and the latter can only rest on the former for a foundation. With Fallenberg of Hofwyl we say: — "My leading doctrine is, that to make these poor people *better*, it is necessary to make them more *comfortable*." If, as is too often the case, one room serves for living-room, kitchen, scullery, larder, bed-room, and hospital, for two or more families, none can wonder that the wretched inhabitants are driven by this utter miserableness and discomfort to seek solace in the tap-room, and excitement in the brilliantly lighted gin palace." "Uncouth, mean, ragged, dirty houses," remarks Dr. Dwight, "constituting the body of any town, will regularly be accompanied by coarse and grovelling manners." It is only latterly that these views have been generally acted upon. The nations of antiquity, noble and inspiring as were their public structures, models of a taste that will ever command reverent admiration, seem to have given but little attention to the dwellings of the lower orders. But it is in modern days, and in this country more especially, that earnest and active efforts have been made practically to better their condition. We are aware some have thought it an evil to do so; and of these Mr. Mc. Culloch and Mr. Hodges M. P. have stood prominently forward, recommending the razing of cottages to the ground, and driving away those who are at all likely to become burdensome to the parish authorities. Where they are to go, these gentlemen have never explained. We feel that we should be insulting the common humanity of our readers by entering into any refutation of their arguments. We shall

endeavour to lay before them information applicable to all parts of the kingdom, and which will guide those who require instruction, and are about to erect dwellings for their less fortunate, but not less human fellow beings. The designs given provide all essential requisites within a small compass, and for a moderate outlay.

OBJECTS.

The general objects to be attained in the erection of dwellings for the labouring classes may be broadly stated, as health, convenience, and economy.

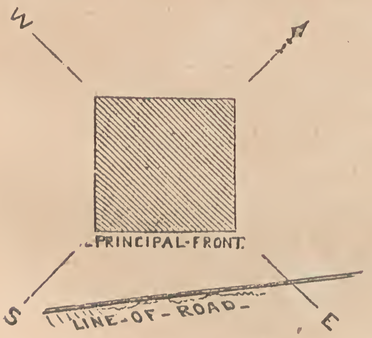
Health, by rendering the building free from damp, and by efficiently warming, ventilating, and supplying it with light.

Convenience, by combining in the smallest commodious space the accommodation necessarily demanded.

Economy, by doing this with the least possible expenditure of labour and materials, and with the cheapest materials commensurate with durability. These are the several objects set before us, and which we shall now endeavour to illustrate and attain.

SITUATION, ASPECT, AND PROSPECT.

Two important requisites of an agricultural labourer's cottage are, that it should not be far from the scene of his daily avocation, and be surrounded by a garden; one sixth of an acre being usually considered the minimum space. The most convenient situation and that generally selected, from its convenience of access, is a few yards from a public road. A small portion of the ground attached should always be in front; as well for the advantage of certain desirable privacy as that it may be appropriated to the cultivation of a few herbs and flowers, better separated from the kitchen or produce part of the land. The cottage should not be placed parallel to the road, but at an angle, that a view may be obtained, not only in front but *down* the road. The aspect will, doubtless, be nearly always contingent on circumstances. Where, however, the power of choice exists, that towards the S. E. from which, in this country, the wind blows seldomer than from any quarter, should be preferred. The next best is the S.; and if the bed-rooms front the E. there is the advantage that the first rays of the sun may remind the industrious labourer of the duties of the day. If possible, the cottage should be protected from the N. by trees; but these have their disadvantage in deteriorating from the value of the ground. That position is the best which enables the sun to shine on all sides of the dwelling; and this may always be obtained by placing the square of the plan diagonally with the cardinal points, so that a N. and S. line passes through the angles, the principal front being towards the S. E. as shown in the margin, which also illustrates the relative position of the road.



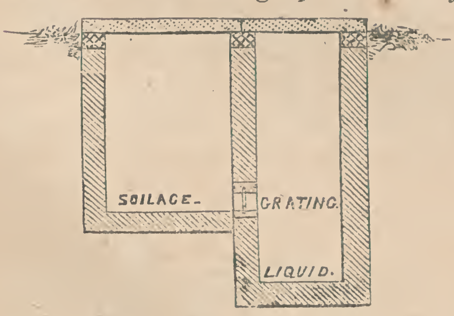
FOUNDATION AND SOIL.

A strong gravelly soil is the best for building upon; it is very incompressible, easily levelled, little affected by exposure to the atmosphere, and there is least to be apprehended from damp and an insecure foundation. A bottom of solid rock is as troublesome to deal with as it may be secure; sand forms an excellent foundation, if it can be kept from escaping, which is very rarely the case; but clays must be carefully guarded against, as however hard at first—and blue shale sometimes requires to be blasted with gunpowder—they are

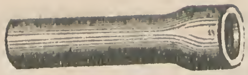
extremely liable to run into sludge. It is, however, necessary for the agricultural labourer that the soil should be adapted for spade husbandry. The foundation is of the highest importance, as on it the building entirely depends, and the greatest care should be devoted to its security. If the ground is at all doubtful, concrete ought to be used. It is composed of one proportion of lime, mixed with six of gravel and broken stones, passed through a sieve of an inch mesh, all well worked up together, and tipped over from a barrow at the lowest possible level. Its cost may generally be set down at from 6 to 8 shillings per yard cube. Care should be taken to keep the trenches no more than of the exact width required, that there may be a firm abutment on each side of them, which cannot be the case when earth is cast loosely in, through carelessness in excavating too much. As concrete is an excellent preventive of damp, it would be as well, if the expense allowed of it, to spread a layer, 6 inches in thickness, all over the surface of the ground to be built upon. Under the walls, it may be a foot in thickness, and twice the width of the lowest course of footings. These latter must be very carefully built; if of stone, with the largest blocks; if of brickwork, with the hardest and best burnt stocks, none of them broken, always breaking joint, no one course to project more than 3 inches beyond another, and the bottom courses invariably double. The evil effects of damp rising in a dwelling can hardly be exaggerated; undermining as it does the health of the inmates and gradually spreading decay amidst all the constructive parts of the house, as well as the furniture and fittings, the clothes, the linen, and all else there is in it. We have already mentioned the expedient of spreading a layer of concrete over the whole surface occupied; but this is costly, and, generally speaking, it will be found sufficient to spread over the surface of the walls, 9 inches or a foot above the ground level, a layer of asphalte $^3/_8$ of an inch thick: of cement $^3/_4$″, or 1″ thick, or gas-tar, mixed with sand: a layer of rough slate slabs, bedded in cement, or any other material which may be cheap and at hand in the district and fitted for the purpose.

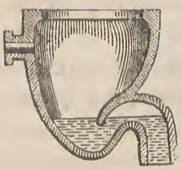
DRAINAGE AND SUPPLY OF WATER.

In planning labourers' cottages, these are points second to none other in importance. The cottage should be elevated at least 2 or 3 feet above the road, with a gentle fall all round to facilitate the drainage and escape of water after heavy rains. It is not necessary for us here to enlarge on the importance of retaining the liquid-manure, even every washing and soap-sud, in a tank as far as possible from the cottage, and at a distance from the water-tank and well, so that nothing may be lost and all the refuse may be available for enriching the land: 5 or 10 shillings per acre may thus be added to its value. A coat of ashes from the



fireplace, or a thin layer of mould daily added, will increase its value as a manure, and tend to retain the noxious carbonate of ammonia rising from it. Drains should communicate with the manure tank from the water-closet, sink, and shed for pigs. Mr. Loudon, in his work on Cottage Architecture, mentions a method of separating the liquid manure from the soilage, which should always be put in practice. It consists in inserting a grating (which is best of galvanized iron) at the bottom of the soilage tank, through which the liquid passes into a well, out of which it can be pumped or removed with a pail when required. We give a modified form in the margin. Brick drains are now being superseded by those of earthenware, which are cheaper and more efficient, on account of the narrowness of surface over which the liquid flows.





They are manufactured in various parts of the country in two feet lengths, with bends and junctions; they are less likely to get out of order than brick drains, can be more readily examined and repaired; are rapidly laid down, and are not liable to be infested with vermin. When glazed, the water flows through them with perfect facility, and the joints may be made good with punned clay or cement. An excellent water-closet basin, ready trapped, may be procured for 7*s.* 6*d.* The drains should be laid to a fall of 1/4" to a foot. The greatest care should be bestowed on properly trapping them, as, unless this is efficiently done at the water-closet and sink, it will be impossible to keep the air in a dwelling house pure. The convenience of having a water-closet in the house is obvious; and, if properly trapped and the refuse be carried immediately off, it may be made as healthy as any other room. Privies should be invariably discarded, and as much in the poor as in the rich man's house: the mere pits under them, generally without enclosing brickwork, allow the contents to permeate the soil, and they are thus often found to drain themselves, the noxious gases escaping to the surface of the ground and contaminating the atmosphere around.

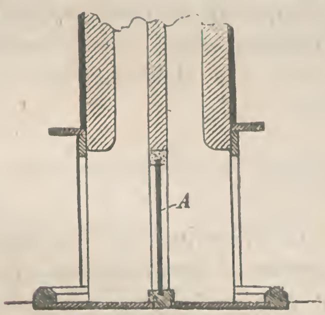
The supply of water will of course depend on the locality. That collected on the roof should be conveyed to a rain water-tank, and a well be sunk for hard water: in both cases the water may be either drawn up when required; or, what is better, a pump with a length of piping supplied, and placed, one out of doors and the other by the sink. Where there is a row of cottages, it is often found convenient to arrange one or more pumps to be used in common. It will be best to supply the cistern over the water-closet by means of the pump, as the water from the roof may not be always sufficient for the purpose, and the necessary flushing of the drain is thus neglected. The mode of fitting it up will be described in the specification. Filters, attached to tanks, are expensive and often useless: every cottager should be supplied with a small filter for drinking water, and its cheapness will always allow of its adoption.

VENTILATION AND WARMING.

It is well observed by Mr. Tomlinson, in his excellent work on Warming and Ventilation, that, "as no person would consent habitually to swallow a small portion of liquid poison, knowing it to be such, though diluted with a very large portion of pure water, so is it equally unwise to consent habitually to inhale a small portion of gaseous poison, knowing it to be such, though diluted with a very large portion of pure air; and yet this is what the majority of persons actually do who occupy apartments unprovided with proper ventilating apparatus." The poor man requires fresh air as much as the rich, and we shall therefore make a few remarks on the subject. Every room in his humble dwelling should be furnished with a distinct means of ventilation, and this should be considered an absolute necessity by all who wish to provide him a healthy home. It has been asserted that a sufficiency of fresh air always enters a room through chinks in the doors and windows, but such is by no means always the case. Means should be supplied (and this may be done very cheaply) of admitting fresh air at a low level by cast iron air bricks and perforations in the skirtings covered with zinc (60 apertures to the square inch to prevent draught), with other openings at or near the level of the ceiling, to allow of the escape of the vitiated air: these latter may be covered with thin pieces of wood, bored with holes, or simple zinc valves, opening outwards only: the inlets to be larger or more numerous than the exits, thus breaking up currents and draughts. It is of little use, admitting fresh air through one opening, if there

be not another for it to escape out of when vitiated, and *vice versa*. When there is a fire in the room, the best exit is by means of a simple valve, or one of Dr. Arnott's ventilators leading into the flue a little below the ceiling level; the valve, opening only into the chimney, allows the foul air to escape into the rapid draught caused by the fire, and precludes the possibility of smoke entering the room. Dr. Arnott's contrivance may be purchased of plain iron for six shillings. In bed-rooms, a wood ventilator, as before described, is best placed flush with the ceiling, thus communicating direct into the roof space, which should have a flow of air through it promoted by means of two or more air bricks, placed in the outer walls. Similar contrivances should be adopted at each floor; and the air, circulating below the ground-floor joists, will tend materially to keep the building dry.

It may be laid down as a principle, to keep all fire-places and flues in interior walls, as then the heat is much more readily retained in the house, and the fuel economised. The open fire-place is so essential a comfort in the eyes of Englishmen, that we repudiate entirely any idea of recommending close stoves, as giving a higher degree of warmth, and being more economical in the working; and there is no occasion to urge the many objections against their use. The very sight of a cheerful fire and its enlivening light, casting antic shadows about the room, is, in itself, sufficient to revive the drooping spirits of the labourer, just returned, wet and wearied, from a hard and cold day's exertion. There are several varieties of ranges; the Derby range and that registered by Mr. Nicholson of Newark are well known. We recommend a range with a small oven and boiler, as most convenient, and the price will allow of its introduction. The cooking range should be fixed in the scullery, as it is desirable to keep the living-room as clean and neat as possible; and in summer, the heat and steam arising from cooking operations is far from healthy or desirable. Two, at least, of the three bed-rooms should be supplied with small stoves; and, when the arrangement of the rooms will



allow of it, the method of heating two rooms by one fire, described by Savot and shown in the margin, may be applied. *A*, is a plate of iron beetween the two, and if the flue in the room without a fire be closed, the fire in the opposite room will be found to heat the other tolerably well. Iron moveable fenders should be discarded, as liable to get out of place and be knocked about and damaged, and the hearth be surrounded with a fixed stone fender, which, with the rounded breastwork and contracted opening, to facilitate the ascent of the smoke, are also illustrated.

CONSTRUCTIONS AND MATERIALS.

The materials to be used in the construction will vary according to the part of the country in which the cottages are to be erected, as a long cartage will add materially to their cost. In some districts, stone will be found the cheapest, as well as the best material; and all we need here remark is, to be careful to place it after carrying so as to know which is the natural bed, and that it be placed upon it on the walls. Bricks are of various kinds; stocks, place, first and second malms, red, white, etc. In the west of England *cob* walls are much used, and building *en pisé* may be adopted in most parts of the country. Building walls with timber is obviously undesirable on account of its liability to destruction by fire and damp; yet many old houses built with it, plastered over, have lasted for centuries: they should be always raised on footings of brick or stone. The timber used will probably be that which is nearest at hand. It is recommended however not to cut it before the tree has arrived at maturity, and, as soon as felled, it should be laid up in some dry place, and as long a

period as possible be allowed to elapse before it is worked; as, if not properly seasoned, the effects will be speedily visible after it is fixed: washing it with charcoal and water is a cheap mode of seasoning. Baltic, Scotch, or American fir timber are generally used; that from Riga is decidedly the best imported; and the deals from Norway are most to be depended upon. Larch is excellent for building purposes; the Swiss cover their cottages with shingles made of it. If possible, the joists and plates next the ground should be of oak, as also the wood sills.

WALLS.

Mr. Loudon has fixed on 18 inches as the minimum thickness for external walls in this country, and they should certainly not be less than 14 inches. If possible, they should be built with a hollow space of 2 or 3 inches in the centre, by which means a more equitable temperature is preserved in the cottage, and damp is avoided. A cheap mode of doing this was proposed by Mr. Loudon, and is illustrated in the margin. He remarks, that "walls built in this way are handsome on the fair side; at least equally strong as solid walls; always dry, and less easily penetrated by cold in winter, or heat in summer. The inner surface, being uneven, is peculiarly favourable for receiving, and retaining the plaster." Hollow bricks were employed in the erection of Prince Albert's Model Cottages, now in Kennington Park. These bricks assist ventilation, secure warmth and dryness, prevent the passage of sound, are usually better dried and burnt than the ordinary stocks, and may be so laid, with glazed facing, as to obviate the necessity for plaster inside the house. In the description of Prince Albert's Houses, it is stated that, where "hollow bricks *are* obtainable at a fair price their use *ought* to effect a reduction of about 25 per cent on the cost of the brickwork." We leave it to our readers to endeavour to obtain them at this "fair" price. These bricks or ordinary bricks, bricknogged, are best for internal walls.

Rubble stone walling will be preferred in some districts; but the use of hewn stone outside and rubble within should be avoided, on account of their diverse settlement. An excellent and economical wall may be formed of a rubble or concrete, composed of broken flint-stones and gravel, picked up in the fields, passed through a sieve of an inch mesh, and worked up about 12″ in thickness with good grey lime. Flint walls are very durable; they are built up in frames on foundations of brick or stone work. Cob walls are made of moistened clay, mixed with water, and formed in frames in courses of about a foot in height; one course being allowed to dry and set before the next is laid on it. Mud walls are formed with clay, moulded in blocks, dried in the sun, and laid with mortar. Walls constructed *en pisé*, are far more lasting than the two preceding, and they are built without mortar. In the environs of Lyons, this mode of building has long been practised, and it is described by Pliny, in his Natural History, as in use among the Romans. Strong earths, with a mixture of gravel, are most suitable to the purpose. The footings are formed of bricks or stones, and frames and planks are so fixed as to admit of the earth being thrown in and well rammed for solidity and to force out the superfluous water; after which the planks are raised and another course formed; each being about 2 or 3 feet in height; the exterior may be either plastered or rough cast. These walls will be found astonishingly durable; they dry rapidly, can be executed in a short space of time: and the houses may be occupied almost immediately after they are finished.

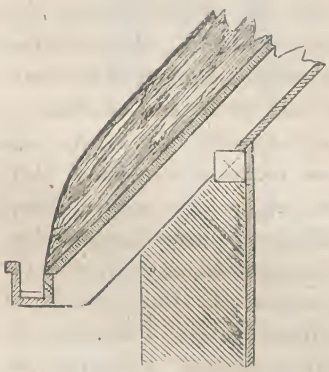
FLOORS.

Boarded floors are decidedly the most comfortable and agreeable. Bricks, laid flat on dry rubbish and jointed in mortars are cheap. In the midland counties, lime-ash floors are much

used. Lime ashes and sand, in the proportion of 1 to 3 are laid (if on joists, on reeds or laths,) about $1^1/_2$ or 2″ thick and well-beaten and trowelled to a smooth surface: the underside may be plastered and whited, thus obviating the necessity for an additional lathed ceiling. Stone floors — of Yorkshire stone for instance — will be found cheapest in some districts. A layer of concrete, 6 inches thick, tiled or cemented on the surface, forms a first rate floor, impervious to damp. Asphalte has been used, but it is not advisable on account of the effect of warmth upon it. Bricks laid thus, and tiled over, tend to prevent moisture rising. Three courses of tiles in cement, breaking joints, may be used without joists for small bearings; and two courses similarly laid on joists 2′ 0″ or 2′ 6″ from centre to centre. When it is desirable to have the upper part of a cottage fire-proof, arches rising 9 inches, and $^1/_2$ brick thick (best of hollow bricks) may be turned on small cast iron girders about 5 feet apart, tied in with wrought iron rods, connected with cast iron springers; the underside may be plastered to form ceiling and the floors boarded, cemented or tiled. Floors ought always to be laid with a slight slope, to facilitate cleaning operations; and those next the ground elevated 9 inches or 1 foot above it. Skirtings should be invariably used.

ROOFS.

The roofs should be framed in the most simple and inexpensive manner; they ought to project from the walls as much as possible; and valleys, which retain decaying vegetable matter, are to be avoided. As much height as is convenient, should also be given to them, that the snow may be speedily dislodged, and the descent of the water, after heavy rains, facilitated. With reference to the coverings of roofs, the advantages of thatch are its cheapness and warmth, and it is, perhaps, of all coatings, that which is least liable to admit changes of temperature. The disadvantages are its liability to take fire and rapidly consume, and also to become a harbour for insects and vermin; and it is not found, in the end, to be economical: soaking it in alum water and size lessens its liability to combustion. The diagram illustrates its application, with wood gutters, which latter must be well painted. Slates form one of the best and, in the long run, cheapest coverings of roofs. They should be nailed on fir laths, or Petersburgh red wood laths $1^1/_2″ \times {}^1/_2″$ or $^3/_4″$. Tiling will be preferred in some districts, with either plain or pan-tiles. The latter, sometimes called Flemish tiles, have no holes for pegs, and are not suitable for very high pitched roofs; they are also very weighty and require the supporting timbers to be of proportionate scantlings. Plain tiles have two holes in each tile, and are fastened by means of oak pegs or nails; they are however heavy, but their appearance is exceedingly pleasing, especialy when laid in ornamental patterns; and they form a durable and excellent covering. Ridge and hip tiles are generally 13 inches long and 16 girt: the valleys may be formed with circular valley tiles, whatever the covering material. An ornamental tile cresting to the ridges is productive of a most pleasing effect, and adds but a trifling sum to the outlay Zinc is a comparatively new material for roofs in this country; and, owing to its having generally been applied of insufficient thickness by incompetent workmen, it has been objected to by many. When, however, it is properly fixed, of sufficient guage, it forms a durable and most economical external coating, and its lightness involves a considerable reduction in the cost of the timber framework: it may also be applied without any woodwork. A square of 100 feet of zinc, at 22 oz to the foot, (No. 14 guage) weighs 150 lbs; the same surface in Bangor Queen slates weighs 830 lbs; and, in plain tiles



1,900 lbs. Zinc is consequently $5^1/_2$ times lighter than slates, and nearly 14 times lighter than tiles, in addition to the saving by the lightness of the timbers and the supporting walls. As compared with lead, a sheet of zinc, of equal thickness to one of lead, is only two-thirds the weight; its strength, or sustaining power, is four times that of lead, and the cost of the two materials, applied of the necessary comparative weights, would be as 1 to 6. The "Vieille Montagne" zinc is by far the best; and it may be procured, of excellent quality, from Mr. Frederick Braby's works in the New Road, London. We shall again recur to this subject when treating on metals. Lead or zinc may be used for the flashings; but fillets of slate, or tiles, or pointing with cement, if carefully executed, will be found effectual. Wood gutters can scarcely be recommended; these and the down pipes, should be of cast iron or zinc: if of zinc, Nos. 13 and 14 guage are the best; the brackets to be of tinned iron. Shingles may in conlusion be mentioned as sometimes used for covering roofs. They are oak boards, generally 8 to 10 inches long, and 4 inches broad, thicker ot one end than on the other.

PIG-STIES.

Where pig-sties are allowable, it should never be left to the cottager to patch them up himself, but they should be properly constructed at the greatest distance from the house, ventilated and drained into the manure tank. Many diseases of animals, — and the Pleura Pneumonia may be mentioned — arise from decomposing matter and bad ventilation: all stagnant matter should be periodically washed and cleared away from the sty; and the sleeping places ventilated by small louvres. The walls should be of brick or stone; the fencing and doors to be of oak; and the paving may be of stone pitchings.

FINISHINGS TO COTTAGES.

The exterior walls may be whitewashed, coloured, or rough-cast. Whitewash is disagreeable in effect from its strong glare. A superior limewash is described by Mr. A. C. Smeaton. "Take a sufficient quantity of small pieces of the best lime, and pour clean water upon them, stirring the liquid for some time. Then let the solution remain for a few minutes, and pour it off into another vessel, leaving the heavy particles behind. Add more water, stirring it as before, and leave it again to settle. Then pour off the water from the top, and strain the whole through a very fine sieve, and keep it covered until wanted for use, when a sufficient quantity of water to reduce it to the proper consistence may be added." Colouring is excellent, and may be varied in tone. Rough-cast is gravel and lime, laid on a second coat of lime and hair while the latter is wet. Cement has not only the advantage of appearance, but tends to keep the walls dry. Portland, Roman, or other cement may be used. Lime and hair plastering, with fanciful impressions of forms made while the plaster is wet, is cheap and pleasing in effect. The interior may be rendered, or laid and set with plaster, or limewhited; the limewhite mixed with a due proportion of tallow, to prevent the work rubbing off. It is good practice to colour the walls while the plaster is yet wet, something on the principle of fresco; or the walls may be rendered and set, finishing them with sharp sand, to resemble trowelled stucco, and coloured when dry. The ceilings should be whited; the partitions and ceilings lathed; the wood partitions with single laths ($^1/_4$" thick), and the ceilings with lath and half or double fir laths; cast iron nails to be used for fir, and wrought iron for oak laths. Laths are best in about 3 feet lengths. Care should be taken in plastering to avoid blisters, caused by the use of unslaked lime; and cracks, arising from the unequal contraction of the plaster. A small cornice may be run to the living-room. French plaster has the advantage of drying quicker, with a harder surface, than common plaster, and it is also cheap. There are various artificial cements or plasters, but these are, in general, very expensive. The living-room, at least, and the bed-rooms in every cottage should be papered;

and, papers being so cheap, there is hardly an excuse for not applying them. All the wood and iron work ought to receive four coats of oil paint. Zinc paint is innocuous; its application not being liable to be attended with such disorders as paralysis, painter's cholic, etc., to which the habitual use of white lead paint leads; and there is generally an inferiority of price of about 9 or 10 per cent. Staining the timbers may be substituted internally for painting. Sanding outside painting is a good practice. The windows may be glazed with crown or sheet glass, crown glass quarries, etc., in small panes, that the expense of repair may be slight and there be no inducement to substitute paper for glass. All the fastenings to windows, doors, etc., should be of the simplest possible character, and such as will be least liable to get out of order and give trouble; and the same rule is to be observed in the internal fittings-up.

IN THE ELEVATIONS

character and simplicity should be aimed at, together with such an amount of picturesque effect as is compatible with the sum proposed to be expended: and it may be observed, that this can be obtained for a very slight additional sum, so slight that it will hardly be worth consideration in balancing the advantages derivable from it. The practice of training trees and flowers up the walls is objectionable, however pleasing the effect may be, as they harbour insects and retain the damp after the rain is driven against them.

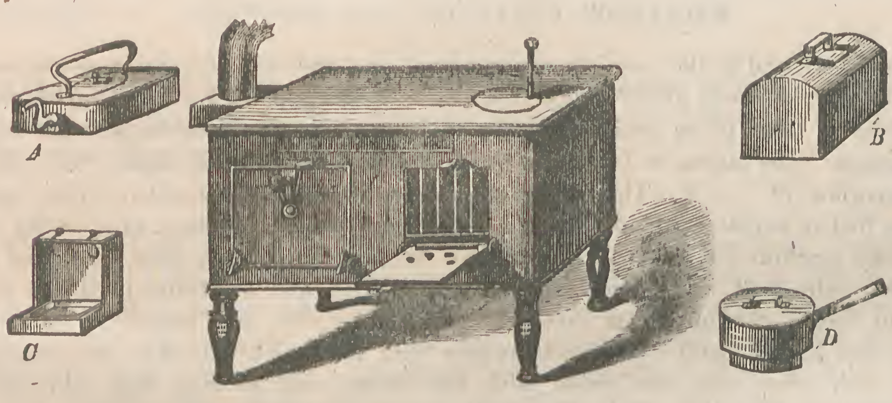
GENERAL INTERIOR ARRANGEMENT AND ACCOMODATION.

Cottages for the labouring classes should be either single or in pairs. If single, there is a greater amount of independence, and it is the sole means of obtaining the desideratum of the sun shining on all sides during the day. Double cottages are built much cheaper than single; and an aspect of greater importance and more picturesqueness of external effect can be obtained. They add besides much to comfort and convenience in the events of sickness and trouble; and a friendly neighbour will be a material addition to the cheerfulness and happiness of the respective inmates. Against a long range of cottages many objections may be effectively urged; the sun generally shines chiefly on one side only, and habits of demoralization, gossip, and idleness are promoted.

The arrangement of the rooms, either wholly on the ground floor or partly above, has each its peculiar advantages and objections. If they are all on the ground level, each room may the more readily be ventilated into the roof space; there is an additional roof surface for the accumulation of rain water; stores may be formed in the large expanse of the roof, and the space and expense of a staircase is gained. But against these advantages must be set: — 1. the extent of ground occupied; 2. the increase of cost arising from the greater amount of excavation and walling; 3. the desirability, from considerations of dryness and airiness, of placing the bed-rooms as elevated as possible, so as to be least liable to be filled with the steam, damp, and effluvia rising from cooking, cleaning, etc.; and 4. the desirability of the more important exterior effect which elevation gives. Considerations of health, expense, and ground space have therefore induced us to give a design comprising two floors.

In considering the amount of accommodation to be given, the prevention of facilities to induce the tenant to let off a part of his dwelling to lodgers must be kept in view; as each cottage should be occupied by only *one* family, and thus all promiscuous mixture and over-crowding is avoided. We set down the minimum of accomodation as a living-room, scullery, and three bed-rooms; one for the labourer and his wife, another for the boys, and a third for the girls. The living-room should be exclusively devoted to the purpose its name indicates, and the scullery be so fitted up as to allow of all the cooking and cleaning being done in it. By this arrangement the former is always kept clean; unwholesome heat in the living-room, in the summer, is avoided; and that order and cleanliness, so pleasing in a

cottage and so desirable to inculcate as habits in the labouring classes, are promoted. Where there are only two bed-rooms, the children of both sexes frequently sleep together; if, therefore, the decent proprieties of life are to be encouraged and promoted, there is an absolute necessity for three bed-rooms, and they should always be so arranged as to obviate the necessity of passing through one to go to another. The front entrance-door ought never to open into the living-room; there should be a porch where the labourer can deposit his tools, without having occasion to bring them into the house, or, what is better, such an arrangement that the entrance so combines with the staircase as to obviate the extra expense of a porch. Pins for hats and coats should be provided here. The staircase ought to be in such a situation that its space may materially assist the ventilation of the house; it has been well termed the main air sewer of a dwelling; and it should never form an ugly projection into a room, or a dark nucleus in the centre of the cottage. Neither should it be essential to pass through any room from the entrance-door to get at it; as, at all times, including those of sickness and death, it will be preferable to make all the bed-rooms directly accessible by the staircase from the entrance-door. The living-room door ought to be next the front entrance; the scullery-door to open into the living-room, and a back-door communicate between the former and the yard. The living-room should be fitted with a dresser, a dwarf closet, by the side of the fire-place, and shelves for books over it: the scullery to have an oven for baking bread which may be either of fire-stone or brick, arched over, with a fire below; or the fire may be lit inside and taken out when the stones are thoroughly heated; a small copper, a sink, pump, and a range, with small oven and boiler should be provided. We have before mentioned



some cottage ranges. The diagram illustrates a cheap and convenient form, which may either stand out in the room or in the usual recess. They are manufactured by Benham and Sons, Wigmore St., Cavendish Square; and a small size may be had including elbow pipe, for £ 2 „ 10 „ 0. There is no boiler, but *A*, is a tin kettle to hold seven quarts; *B*, an iron cover to form an additional oven; *C*, a toaster, and *D*, a saucepan to fit the circular top. Either coal or wood can be used. Another convenient, but more expensive cottage stove has been registered by Messrs. Huxhams and Brown, of Exeter. The scullery should also be provided with a towel roller and an ironing board or table, hung on hinges, supported by iron or wooden legs, made to fold or remove; and this may sometimes be so arranged as to lift up and form the shutter to window; the iron or wood leg serving as the shutter bar. A pantry is an absolute requisite never to be omitted, or the food will be scattered about, become dirty and contaminate the air of the rooms, the pantry should not open out of the living-room or scullery, but, if possible, from a passage separated from them. A cellar for wood and coals is necessary, and the water-closet should be attached to the house; as the inconvenience of

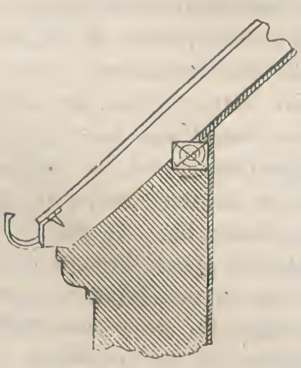
its being far distant must be evident in cases of sickness, inclement weather, etc. A cistern must be provided over it, and supplied with water either from the roof, or, what is better, by means of a pump. If a privy is substituted, it must be placed at a distance from the house; and the receptacle for dust should be out of doors and kept covered. The living-room may be fitted with an ordinary fireplace; two, at least, of the three bed-rooms must have stoves; and one or more closets for clothes and linen should be placed on the upper floor. Shutters are not absolute necessities, but may be easily and economically fitted up; they certainly add to the warmth of rooms during the long winter evenings. The height of the floors should be, at least, from 8 to 9 feet; low rooms being as unhealthy, as they are inconvenient and disagreeable.

Two Designs are submitted, and on referring to them, they will be found in themselves sufficiently explanatory. It has been endeavoured to combine in the most convenient manner, without loss of space, all the accommodation above described. They are laid before the subscribers as most commodious and economical cottages of their class; and they may be erected either singly or in pairs. The various materials which can be used have been already described, and the locality will determine their application. If erected in accordance with the following Specification, it is estimated that the pair can be built in the home counties for £ 220. If let at the rate of three shillings per week each, a return of seven per cent will be obtained on the immediate outlay. Of course, if the proprietor makes his own bricks, cuts the timber on the estate, or the carriage of materials is but trifling, a deduction of 10 or 20 per cent may be made.

SPECIFICATION.

EXCAVATOR, BRICKLAYER, AND PLASTERER.

Excavate the ground to the requisite depth; level and well ram the same as the works are brought up. All the bricks are to be the best, hard, well burnt stocks, laid Flemish bond, the most uniform in color to be selected for the external facings, and the hardest and best burnt for the footings. The mortar to be composed of grey lime, mixed with clean, sharp river sand in the proportion of 1 to 3. Thoroughly bond together the brickwork; no four courses to exceed one foot in height; bed and point all door and window frames; turn arches over all openings with carefully cut skewbacks; and keep the external pointing neat, close and parallel; build fender walls, half brick trimmers, and dust places; and brick-nog partitions on upper and ground floors; carefully form flues 14″ × 9″, and core and parget the same; bed all wall plates and lintels: build ovens and coppers with hard picked bricks; the former to have $^1/_2$ bricks arch over; case the inside with fire bricks, and provide them also to copper, where exposed to the action of the fire; also provide rounded bricks to both. Fix 12 cast iron air bricks to each cottage where directed. Lay over the whole surface of the walls, 6 inches above the ground level, a layer of gas tar, mixed with sand to prevent damp rising.



Pave the scullery; coal cellar, and W. C. with stock bricks, laid in mortar, on a layer of dry, well rammed rubbish. The eaves and gables to be finished with rounded bricks, as in the margin; and insert chamfer bricks to doors and windows, and finish chimneys as shown. Stoneware tubular drains, 4 and 5 inches diameter, properly trapped; and with a fall of $^1/_4$″ to a foot, to lead from sinks and W. C. to manure tanks, constructed, as shown in the diagram before given, of brickwork and Yorkshire stone; and the size of which is to depend on whether or not the same tank is to serve for both cottages. A rain water-tank and a well are also to be formed, the size of the former to depend on the same contingency. The water-tank is to be executed in 9 inch work in cement, and

the interior rendered with pure Roman cement $1^1/_4''$ thick; $9''$ invert bottom and domed top, and $4''$ York cover-stone to manhole $2'$ „ $3''$ diameter, with wrought iron flush ring, screw and flush ring complete: conduct the water in $4''$ stoneware drains. The well is to be steined in $^1/_2$ brick, with covering similar to tank: it may be four feet in diameter. The quoins and dressings are to be executed in Roman cement to a floated face, $^1/_2$ cement and $^1/_2$ sand, and to be not less than $^3/_4''$ in thickness. Execute the internal plastering with well burnt chalk lime, clean sand and strong hair; the laths to be lath and half laths, nailed at both ends with cast iron nails. Render and set for paper the internal walls, and white ceilings of living rooms, pantries and rooms on chamber floors: the remainder are not to be lathed; but the joists and boards limewhited; also the underside of stairs. Limewhite twice the sculleries, coal cellars, pantries, and W. C. Put cement skirtings $4''$ wide to sculleries, and W. C.

MASON.

The door steps to be of tooled York stone $14'' \times 6''$, and $6''$ longer than the respective openings, morticed for door posts. The landing at front entrance to be $4''$ thick, of the size shown, pinned into wall, with chamfered corner. The sills to windows to be of tooled York $2^1/_2''$ thick, laid with a slope under oak sill, and to be $4''$ wider than openings. The chimney pieces to be all of Wilkinson's artificial stone; those to the bedrooms, 6 shillings each; the remainder 10 shillings each. The hearths to be of York stone, 1 foot longer than openings, and eighteen inches wide, with fixed stone chamfered fenders around, $4^1/_2''$ high and $3''$ thick (see diagram ante). Sink stones of the size shown, $7''$ thick and $4''$ deep, perforated and rebated for $4''$ bell traps.

SLATER.

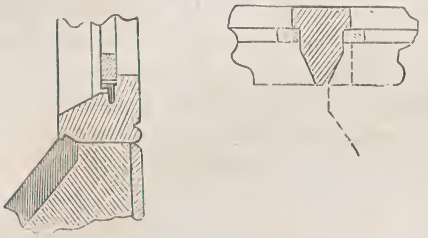
Cover the roofs with Bangor Countess slating, on $^3/_4''$ battens, $1^1/_2''$ wide, nailed with composition nails, with $2^1/_2''$ lap: cement filleting next chimneys and walls. Cover the ridge hips, and valleys with ridge, hip and valley tiles jointed in cement.

CARPENTER AND JOINER.

The oak to be English; the Fir Memel, and the deals Christiana; all of good hearty quality. Get out the timbers of the scantlings, and frame and gut them together in the manner shown and described. Lintels over all doors and windows, $4^1/_2''$ deep and $18''$ longer than openings. Provide all necessary fir bricks, battening for slates, fillets, etc. and no joists and rafters to exceed $12''$ apart. The roofs to have rafters and ties $4^1/_2'' \times 3''$, halved and pinned together, ridge valley and hip pieces $7'' \times 1^1/_2''$, and plates $4'' \times 3^1/_2''$. The roofs over entrance to be framed as shown, with rafters $4'' \times 2^1/_2''$, upper plate, secured to wall, $5'' \times 2^1/_2''$; lower plate $9'' \times 3''$; the supporting brackets housed into walls. Inch yellow deal gutters, edges shot, on proper bearers, laid to a fall, and $9''$ wide at the narrowest part. The joists on ground floor to be $4^1/_4'' \times 2^1/_2''$; on chamber floor $7'' \times 2^1/_2''$, with trimmers and trimming joists $^1/_2''$ thicker; plates $4'' \times 3''$. The flooring to be inch yellow deal straight joint; that over sculleries and offices to be inch $^1/_4$, ploughed and tongued with hoop iron. The skirtings to living rooms, lobbies, pantries, and bedrooms to be $^3/_4''$ yellow deal $4^1/_2''$ wide. The staircases to have $1''$ treads, $^3/_4''$ risers, $1''$ string boards, firmly bracketted, glued and blocked; deal turned newel and handrail $2^1/_2'' \times 2''$, with inch square balusters, where requisite; $^3/_4''$ lining round trimmer. The closet shown, to be inclosed with $1^1/_2''$ deal, square framed, with similar door, hung on $2^1/_2''$ butts, with iron turnbuckle: two steps of $^3/_4''$ deal where indicated. The W. C. to have inch deal seat and riser, on bearers, with holes cut for handles, and $2^1/_2''$ narrow skirtings round seats, with deal cover. The dwarf closets in living rooms to have $1^1/_4''$ square framed doors, hung on $2''$ butts, with a small lock: fix within a shelf of inch deal, and two narrow shelves above for books. The

bedroom closets to be similar, hung on $2\frac{1}{2}''$ butts, with iron turnbuckles. The cisterns to be the size of the W. C. and 2′ „ 0″ deep, of $1\frac{1}{2}''$ in. deal, wrought, ploughed, tongued and dovetailed; each to have on $\frac{1}{2}''$ wrought iron bolt; fix strong bearers. Provide dressers to livingrooms with shelves, pot boards and drawers; fix inch $\frac{1}{4}$ shelves in pantries; inch $\frac{1}{2}$ clamped ironing boards and frames, made to let down, covers to coppers, and ledged covers hung on cross garnet hinges to dust bins, and all incidental fittings; also seats fitted by the front entrance. The front and back entrance doors to be $1\frac{1}{2}''$ thick, framed, cross-braced and hung with wrought iron strap hinges to rebated frames $4\frac{1}{2}'' \times 3''$; stock locks, 9″ bolts and good thumb-latches. The door frames to W. C. to be similar, with transom $4\frac{1}{2}'' \times 4\frac{1}{2}''$, and additional doors above to get at cisterns, which doors and those below are to be $\frac{3}{4}''$, rebated and beaded, hung with 18″ cross-garnets, and to have hatch fastenings, with small bolts to W. C.; cut holes in doors for ventilation. The remaining doors to be $1\frac{1}{4}''$ four-panel, square framed, hung on 3″ butts to $1\frac{1}{4}''$ rebated and double rounded linings; each door to have a latch and the pantry doors to have 6 inch iron rim locks. The whole of the windows to have solid fir framed, rebated, chamfered and beaded frames $4\frac{1}{2}'' \times 3\frac{1}{2}''$, with inch $\frac{1}{4}$ sashes and zinc divisions, hung on $2\frac{1}{2}''$ butts, with proper stay hooks and hook and eye fastenings. The sills to be of oak $4\frac{1}{2}'' \times 4''$, properly weathered, with galvanized iron water bars. One half of the pantry window is to be filled in with perforated zinc. Attach, flush with the ceiling of each bedroom, a wood ventilator, one foot square, pierced with holes. Dr. Arnott's chimney valves of plain iron, to be fixed in living rooms and sculleries. Communicating with each air brick, either in the skirtings or elsewhere, a piece of perforated zinc (60 apertures to the square inch) is to admit the fresh air.

SILL. MULLION.



PLUMBER.

A pump, with inch $\frac{1}{2}$ suction pipe from well, is to be placed where convenient, if one will suffice. A force pump to be fixed in each scullery by the side of sink, with a length of inch $\frac{1}{2}$ pipe from tank; the water is to be forced to the cisterns through an inch pipe, with an $\frac{1}{2}''$ notice pipe brought back to sinks: line the cisterns with 6 lb. lead. Supply W. C. by $\frac{3}{4}''$ service, with brass cocks, and fit them with stoneware closet pans, with white internal glaze, and properly trapped. The sinks to have 4″ brass grate and bell traps and $2\frac{1}{2}''$ waste pipes delivering into drains. The gutters to be laid with 6 lb. lead, with a proper fall, and 4″ stocket pipes into heads of rain water pipes.

SMITH.

The stoves to be all selected (see ante). Provide coppers in sculleries with proper fittings to these and ovens, and 12 air bricks to each cottage. 4″ eaves gutters and six 3″ down pipes, with heads of a gothic pattern; properly connect the ends with the drains. Fix iron gratings to windows of coal cellars.

PAINTER, GLAZIER, AND PAPER-HANGER

Paint the whole of the woodwork and ironwork where seen, excepting only undersides of ceilings, four times in good oil colors; the woodwork being previously thoroughly stopped and knotted, and the rust on ironwork cleaned off.

Glaze the windows with Crown glass, well puttied and left perfect.

Paper the whole of the internal walls, except those of the scullery and offices, with good common paper of two colours; the colours to be well toned down, and the patterns simple, and without pretension; all representations of natural objects to be avoided.

EDWARD L. TARBUCK.

DESIGN FOR A GENTLEMAN'S VILLA.

PLATE 37.

Plate 37, is a design for a Gentleman's Villa, containing 14 large and convenient rooms, with the requisite offices.

The ground floor is to be raised 2′ „ 6″ above the ground level, and a course of 1/2″ slate slabs, 1 foot above the ground, will effectually prevent damp rising. The remaining elevations are to be decorated in a similar manner to the principal front. The roof over the tower is to be covered with 1/2 inch slate slabs, and the other roofs with zinc, with rolls, as indicated. The roof behind the ballustrade may be constructed as a flat; the door opening on to it to be over the end of the passage space on ground plan. If a sloping roof be adopted, cover it with Countess slating; if a flat, it may be covered with zinc or lead.

The fire-places in Drawing and Dining rooms may be easily shifted, and folding doors introduced. The offices may also be placed behind the Scullery, and their place occupied by a Breakfast-parlor. A small staircase, or step-ladder with handrail, leads to the upper part of tower, which may, if preferable, be glazed in, and thus form, in winter as well as in summer, an agreeable prospect room. The ground and first floor to be 11 feet in height; the second floor to be 10′ „ 6″.

The house is to be erected of stock bricks; the dressings to the windows, quoins, etc., to be run and moulded in Roman or other cement. Fir timber and Christiana deals are recommended, and the joists and plates next the ground should be of British oak. The principal windows to be glazed with plate glass, and the remainder with sheet or Crown glass. The offices to be twice limewhited; the Hall and Passage to be finished with trowelled stucco, flatted drab or grey, and the remaining rooms to be papered. Cornices to the principal rooms.

The cost of this house, if erected and finished in the manner above indicated, the fittings, mouldings, and finishings being kept moderately plain, will be under £ 1,500. The amount for which it would let will, of course, be entirely dependent on the locality.

TWO SEMI-DETACHED SEVEN-ROOMED HOUSES.

PLATE 38

Is the plan and Elevation of two semi-detached seven-roomed houses. The elevations may be carried up in brickwork, with Bath or Caen stone dressings to the doors and windows; or the dressings and all the ornamental work may be finished in Portland cement.

The roofs are to be slated; the valleys to be laid with 5 lb. lead, and all the ridges to have saddle-ridge ornamental tiles.

The accomodation afforded is as follows: —

On the ground floor,

An entrance porch	5′ „ 6″ × 3′ „ 6″
Passage, and staircase	22′ „ 0″ × 5′ „ 6″
A coal cellar under the stairs.	
A front parlor	15′ „ 0″ × 14′ „ 0″
A drawing room	15′ „ 6″ × 14′ „ 0″
These two rooms are connected by means of folding doors.	
A store room	6′ „ 0″ × 4′ „ 6″
A kitchen	14′ „ 0″ × 10′ „ 6″
Pantry	6′ „ 0″ × 5′ „ 6″
A water closet.	
The upper or bedroom floor, comprises,	
A front bedroom	15′ „ 0″ × 14′ 0″

A back bedroom	15′ „ 6″ × 14′ „ 0″
A bedroom over the kitchen	10′ „ 6″ × 10′ „ 0″
Ditto . . Ditto	10′ „ 6″ × 10′ „ 0″

A linen room over the porch.

The height of the ground floor is ten feet in the clear; that of the bedroom floor ten feet six inches, but curved all round circular, and bracketted out to cover the rake of the rafters.

The rafters must have strong collar beams 7 inches by 2½″, well-secured to the rafters at each end; and to the rafter, the brackets of the cove of the arc to ceilings are to be firmly nailed.

The scantlings of the timbers for this erection may be as follows.

Floor joists on ground floor 4″ × 3″; bond timber and wood bricks 4″ × 2½″; — plates 4″ × 3″; lintels 9″ × 3″ —; upper floor joists 8″ × 2″; roof plates 4″ × 4″; collars or ceiling joists 7″ × 1¼″; rafters 4″ × 2″; valley boards 9″ × 2″; ridge boards 7″ by 1½″. The doors to be panelled; the windows to be French casements, glazed with the best sheet or Crown glass; and the whole of the work may be finished, and the two houses completed for habitation for the sum of £ 700.

DESIGN FOR VILLA RESIDENCES.

PLATE 39.

Plate 39, contains plans and an elevation of two semi-detached nine-roomed villa residences with conservatories. They may be erected of bricks, or stone; of bricks with stone facings; or of bricks with the quoins, facings, cornices, and all the ornamental works finished in either Roman or Portland cement.

Each house has the following accommodation. On the basement, —

A coal cellar	8′ „ 0″ × 4′ „ 6″
A wine cellar	9′ „ 0″ × 4′ „ 6″
A beer cellar	9′ „ 0″ × 4′ „ 0″
A passage to area, and kitchen entrance	15′ „ 0″ × 3′ „ 0″
A pantry	8′ „ 0″ × 6′ „ 0″
A kitchen	15′ „ 0″ × 15′ „ 0″
A breakfast room	15′ „ 0″ × 14′ „ 0″

The height of the basement, is nine feet.

There is a roomy closet under the stairs; also a water closet outside the main building.

On the ground floor, —

A spacious entrance hall, and staircase, and water closet.

A dining room	15′ „ 0″ × 15′ „ 0″
A drawing room (clear of the bay window)	18′ „ 0″ × 15′ „ 0″
and which opens by means of glass doors, on each side of the fire place, into a conservatory	17′ „ 0″ × 9′ „ 0″

The drawing and dining rooms communicate by means of folding doors, and the glass doors of the Conservatory being hung by lifting hinges, when they are removed and the folding doors thrown open, a very commodious suite of rooms is obtained.

This story is ten feet, six inches in height.

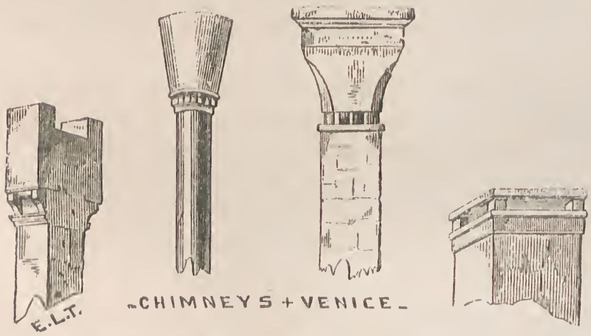
The principal bedroom floor comprises three large bedrooms ten feet high, and the roof will admit of three very roomy attic bedrooms.

The probable cost of the pair of houses, if erected of stock bricks with Roman cement dressings will be £ 1,800. The conservatory could be erected and fitted complete for about £ 150 additional. It is to be glazed with sheet glass.

THE CAUSES AND REMEDIES OF SMOKY CHIMNEYS.

It is hardly possible to overrate the inconvenience, annoyance, and unhealthiness caused by the smoke of chimneys entering and filling an apartment, instead of passing up the flue. There is hardly one practical journal circulating in the land which does not contain frequent applications from its subscribers, complaining of the nuisance, and asking what is likely to be the most effectual remedy. And it is equally true that cures out of number are suggested, applied, and set on one side as ineffectual, one after the other, until despair is the result of the expense and trouble incurred. One great cause of disappointment may be set down to the circumstance that one remedy is presumed to be appropriate to all instances, whereas, in fact, in the pathology of smoky chimneys, as in medicine, there are rarely two cases which admit of precisely the same mode of cure. We see advertised, almost as often as pills and nostrums for all human disorders, notices of chimney-cappings, cowls, patented inventions, etc., etc., for the tops of flues with the consoling and hopeful heading, — "no more smoky chimneys," as if these were invariable remedies and were not, in fact, limited to a few predisposing causes. The belief in their universality is a great mistake, and, as a general rule, it is better to commence operations at the fireplace, where the smoke is formed, rather than climb to the roof and begin thirty or forty feet from the starting point of the annoyance.

A chimney may be briefly defined as a passage for carrying off into the external atmosphere the smoke from a fire in a room or elsewhere. Their extensive application is of modern date. They do not appear to have been common in Egypt, Greece, and Rome, and the warmth of the climate there would, to a certain extent, obviate their absolute necessity, Palladio mentions two; one at Baia, and another near Civita Vecchia, standing in the middle of the rooms, the smoke being conveyed off by means of funnels; and Scamozzi cites three different kinds. The Italians have laid claim to the invention of chimneys, and it is certain they were in use at Padua before 1368; for Francisco da Carrara, the celebrated and courageous lord of Padua, on arriving in Rome in that year, and finding no chimneys in the inn, had two constructed, which are supposed to be the first ever seen in the Eternal City. Venice is remarkable to this day for the picturesque forms of its chimneys; we insert some examples sketched on the spot. An inscription over the gate of the school of Santa Maria della Carita, states that in 1347, a great many were thrown down by the shock of an earthquake. In England there are earlier instances. Rochester Castle, probably the work of W. Corbyl, about 1130, contains flues which go a few feet up in the walls, with exits at the back as indicated. Some years after, flues were carried up above the roofs, as in Sherborne Castle and the Keep at Newcastle. In the fifteenth century the shafts were clustered, thus; but chimneys cannot be considered as having been generally used in this country until the earlier portion of the sixteenth century; the smoke from fires previously escaping through louvres or other openings. "One chymley of stone, and for the tryng



abowte the seyde chymley," is found in an old account of Durham Castle, 1544. In Tudor architecture, chimney shafts are most beautiful features; and in Queen Elizabeth's days, it was usual to apologize to visitors, specially ladies, if there were no chimneys provided to their rooms. It thus appears they were not then generally applied to private houses, although used for many trade purposes.

The principle, on which the effective action of a chimney depends is, that the air within being heated and rarefied, its specific gravity is lessened, and the weight of the column within the flue being less than that without, the heated air ascends in proportion as this is the case, and is replaced by the colder air rushing in from the fire-place opening to supply its place, carrying up with it the smoke, or particles of culm, resulting from combustion. Now, in illustration of that law in physics that the air and all gases increase in bulk in proportion to the rise of temperature, Gay Lussac found that 1,000 cubic inches of air at 32^0 increase to 1375, or $^3/_8$ of the original bulk, at 212^0, the temperature of boiling water; which will be found to be $20^5/_6$ parts in 10,000 for 1^0. To ascertain the rate of ascent in flues, we first obtain the temperature of the column of air within, or rather the mean of the heat at the top and bottom and then apply Montgolfier's formula: — "Ascertain the difference in height between two equal columns of air when one is heated to a certain temperature, the other being the temperature of the external air, and the force of the draught, or the rate of efflux, is equal to the velocity that a heavy body would acquire by falling freely through this difference of height." This is procured by multiplying the fall in feet by 64, and taking the square root of the product; an allowance being made for friction, in proportion as it exists. The above is the rationale of the action of chimneys. Dr. Franklin observes in his celebrated letter to Dr. John Ingenhousz of Vienna, that some think smoke is lighter than air, and others that there is a power in chimneys to *draw up* smoke, when, in fact it is the superior weight of the surrounding atmosphere that *presses* to enter the funnel below, and so *drives up* the smoke. That smoke is not lighter than air may be easily proved: light a pipe of tobacco, put a cloth over the bowl and plunge the stem into a basin of water, then make the smoke descend in the stem of the pipe by blowing through it; it will rise in bubbles through the water and being cooled will spread itself and rest on the surface of the water, instead of rising. Its specific gravity is therefore greater than that of air, and it is only when rarified that it becomes lighter.

The object of the chimney being to convey the smoke from the fire, the first requisite is that the draught of the air should be from the bottom to the top, and this is to be obtained by properly constructing the channel and the openings above and below, and supplying a sufficiency of fresh air at the base of the structure. Where wood is burnt, the great size of the fireplace and flue interfere but slightly in a large room with the ascent of the smoke, but when coal is introduced the circumstances are different. The smoke from coals was deemed an intolerable nuisance when the material was first introduced. In 1306, a petition was presented to the king of England, to prohibit its use in the city of London; a measure was shortly afterwards passed making the burning of it within the city a capital offence; and, in the reign of Edward I, a man was actually executed for thus offending, to the horror of coal merchants at least. Ladies would not eat meat cooked by coal fires; they thought, and are now sometimes justly of opinion, that they injured their complexions. In Queen Elizabeth's Parliament, a motion was made: — "That many dyers, brewers, smiths, and other artificers of London, had of late, taken to the use of pit-coal for their fires instead of wood, which filled the air with noxious vapours and smoke, very prejudicial to the health, particularly of persons coming out of the country," and moving "that a law be passed to prohibit the use of such fuel (at least during the session of Parliament) by these artificers." "Rare Ben Jonson," in his kindness of heart, abstained from the use of coal

while entertaining friends as carefully as we now consider a good fire an indispensable mark of attention to them in cold weather.

Fireplaces are generally made from 2′ or 2′ „ 6″, to 3′ or 4′ in width, and 2′ „ 6″ or 3′ „ 0″ in height. If these dimensions are not sufficiently large, it is better to have two fireplaces, as well to secure the ascent of the smoke as from the furnace-like appearance of one, 5 or 6 feet broad; and two fireplaces will warm a large room better than one. Dr. Franklin truly observes, "that architects, in general, have no other ideas of proportion in the opening of a chimney than what relates to symmetry and beauty respecting the dimensions of the room; whilst its true proportion, respecting its function and utility, depends on quite other principles; and they might as properly proportion the step in a staircase to the story, instead of the natural elevation of mens legs in mounting." He goes on to remark on the prejudice still existing in favor of large chimney openings, and ventures to hope that "in time, perhaps, that which is fitted to the nature of things, may come to be thought handsomest. And there are some I know so bigoted to the fancy of a large noble opening, that, rather than change it, they would submit to have damaged furniture, sore eyes, and skins almost smoked to bacon." The flue must taper backwards from the fireplace in a conical and gradually curved form without projections, and bends in the passage will prevent the wind blowing the smoke directly down. The smaller to some extent the flue and the greater its height, that the column of heated air may be lengthened and the influence of the wind extend a proportionately shorter distance, the more rapid will be the draught, provided a sufficiency of cold air is supplied at the bottom. Flues are generally made too large, 14″ × 9″ being the regular routine size, without the slightest reference to the extent of the fireplace and the apartment; the dimensions being adhered to mechanically, because it is customary, not on account of any scientific principle. But, on the other hand, if the funnel is too narrow to allow an easy passage to the top, the smoke will naturally escape into the room. The flues may generally be made about 12″ square above the throat of the chimney; or the area of the horizontal section of the flue should be equal to the horizontal section of the fire, and this is larger than is needful if the flues are circular and quite smooth. Mr. Tredgold gives this rule for calculating the size of the aperture of the chimney: — "Multiply by 17 the length of the fireplace, in inches, and divide by the square root of the height of the chimney (above the grate) in feet; and the quotient is the area in inches for the aperture of the chimney." All horizontal channels, by allowing the cold air to hang about, tend to cool the flue and lessen the draught, and it is thus easily driven back by gusts of wind. This is, of all kinds of smokiness, that which is most teazing, as every little puff of wind sends a corresponding puff of smoke into the room when least expected. The air should, if possible, pass through the fire, or very near the fuel, so as to lift the smoke directly up; and we thus perceive the evil of a very high opening, by which the air enters the flue, without reference to the fire, entangles the warm air in the channel and prevents it becoming sufficiently heated. The fireplace opening must not, therefore, be much higher than the grate, and all mixture of the warm air above the fire, and about the throat of the chimney will necessarily cause sluggishness in the ascent.

Having made these general remarks on the subject, we will next proceed to state in a little order the causes and remedies of smoky chimneys, when the fallacy of one single specific prescription for the very many causes of the disease, will be sufficiently evident. Before doing so, we have only to state that when we say a chimney smokes, we mean that it smokes in *the wrong direction*, and that when it draws, it draws in the *right direction.*

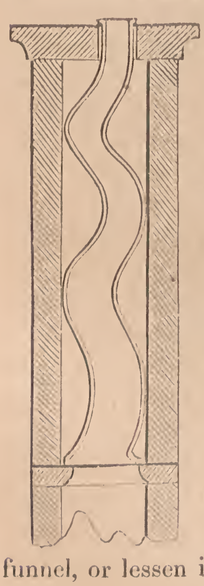
1. One of the most ordinary predisposing occasions of smoke entering a room instead of passing up the chimney is a deficiency of fresh air *from the direction of the*

apartment, to supply the fire and aid the draught. The consequence is, that the requisite air *comes down* instead of *going up* the flue, bringing the smoke with it and reversing its proper direction. The largeness of a room is no argument whatever to show there is a sufficiency of air for the fire, for it cannot spare a chimney-full of it without causing a vacuum. Fireplaces most usually smoke in the wrong direction in new built houses, in which the wainscotting, the joints of the flooring, and the doors and windows all fit with accuracy, perfectly true and tight, and the walls, not being dry, preserve a dampness which swells wood-work and keeps it close. And as, according to the present scientific method of building, means are rarely provided for ventilation, the chimney is actually the sole means of supplying air to the apartment; and so fully are many aware of this fact that they will not sleep in a room unprovided with a fireplace. Or, in old houses, the doors and windows are listed, a mat covers the bottom of the door, sandbags keep out the enemy at the windows, and even the keyhole is stopped. The term "aërophobia" was well applied by Franklin to this dread of fresh air. And is it surprising, that, under such circumstances, the fire should discharge its smoke into the room; is it consistent with science that it should not do so? The room may, in fact, be compared to the exhausted receiver of an air pump, and from whatever direction an opening is made, the vacuum will be speedily filled. The first question is to ascertain the quantity of air requisite to admit into the room to make the fire smoke in the proper direction. This may be obtained, when the fire is burning well, by opening the door more or less so as to admit the necessary supply and observing the width of the aperture. If this is half an inch in a door 8 feet high, it will be equal to an opening 8″ × 6″. Dr. Franklin observes that a hole 6″ square is a good medium size for most fireplaces. The next difficulty is where to place this opening. M. Gauger proposed to admit the fresh air above the chimney opening, first warmed by circulating round the back of the stove; and there can be no doubt of the value of this recommendation. If the aperture is placed in the door, the privacy of the room is interfered with; if over the window, cold air is liable to fall on the heads of all near. It may however be placed over the door or window, or in the skirting, and covered with perforated zinc of ornamental design, which, if it has about 70 apertures to the square inch, will effectually prevent draught. If two, tree, or more openings are made, the currents will be cut up and divided, and draught entirely obviated. As to the objection of fresh air cooling the room, it has been seen that it must be admitted somewhere, and, as before described, it can be introduced in a heated state. The rush of air towards fireplaces was objected to on the first introduction of chimneys. "Now we have many chimnyes, yet our tenderlyngs complain of rheums, catarrhs, and poses, then had we nothing but reredosses (open hearths) and yet our heads never did ache." * A plan which obviates entirely any draught is to have an air duct appropriated to the fire alone and immediately under and in front of it, thus supplying it independently of the air in the room. This may be done in the manner illustrated in the margin: *A*, is a cast iron box, with openings at the side for the admission of air, and with a close iron grating at the top for its escape in the direction of the fire. This grating is made to remove so as to allow of cleaning out of the box; the grating should be too close to allow any lighted fragments to pass it, and the openings at the side of the box should, for the same reason, be small perforations, but the strong rush of air in the direction of the fire would prevent any sparks falling in. The air is to be conducted to this box either

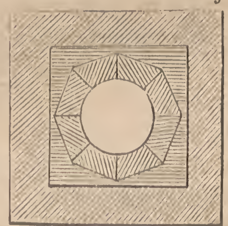
* Holinshed's Chronicle. vol. I. 1570.

in metal tubing or between the joists of the flooring, one or more cast iron air bricks being inserted in the outer wall. The advantage of this expedient will be at once perceived. There is no demand made on the air in the apartment, the fire is fully and independently supplied, and the rush of air will be found so great, that it will be perfectly impossible for the smoke to resist it and pass into the room. All openings at the back of the fireplace, and in the flues have usually precisely the contrary effect to that intended, and register stoves should be built close behind, not leaving the smallest crevice for the air to escape upwards without passing through the fire.

2. A second cause of smoky chimneys arises from the funnel being too short, the ascending current not having then sufficient power to force the smoke up. Attic chimneys and those to low kitchen buildings are peculiarly liable to smoke into the rooms. When the air rushes up a long flue, it gains such a force that it requires a proportionately greater one to drive it back; but in the cases above mentioned this force can seldom be obtained, and if the flue be built high above the roofs it will, in all probability, be blown down, unless firmly steadied by iron rods. In low buildings Dr. Franklin recommends, "the building two or more funnels joining to the first, and having three moderate openings, one to each funnel, instead of one large one. When there is occasion to use but one, the other two may be shut by sliding plates." The more usual remedy is to contract the lower opening and lower the breast, so as to oblige the entering air to pass through the fire, by which means it will be very highly rarefied, cause a strong draught, and thus make up for the shortness of the flue. There are two modes of contracting the lower chimney opening, viz. by lessening that *before* the fire, and the one *above* the fire. If the former is done, the draught will be more powerful, and a greater amount of coals will be consumed; and if the latter, it will be the reverse; for less air passes through the fire; the same as if we lessen both openings, if the upper one is contracted most in proportion. If also a garret chimney is a little turned, and the flue made smaller instead, as is usually the case, of the same size as the others, it will be found



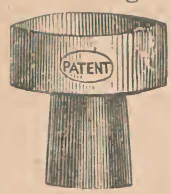
to be nearly as efficient as the larger flues. An earthenware or metal chimney capping may be added at the top. The spiral tube invented by Mr. Fenners and shown in the margin, will be found effectual in many cases. A flue may be decreased in size, see diagram, and the heated air in the



outer chamber will also assist the draught. Flues already built, may be easily lessened by passing up them earthenware socket jointed piping, or metal tubing, if it is expedient to go to the requisite expense. The practice of turning one flue into another from a lower level, is much to be deprecated, as the length of the shorter one can only be reckoned from the place where it enters the longer, and the latter is also shortened by the difference between the point of junction and the top: either a fresh portion of flue must be constructed, or the junction closed; which latter will prevent the return of the smoke into the higher room, when driven back by a gust of wind. The flue may also be in the contrary extreme, too long, and the heat of the ascending current being too distributed the whole will cool down; but this circumstance rarely occurs, and the plain remedy is to shorten the funnel, or lessen its horizontal section.

3. A third cause of smokiness in rooms is, when the tops of the flues are commanded by higher buildings or by an eminence or hill, so that the wind blowing over them falls suddenly down, like water over a dam, — sometimes almost perpendicularly on the tops of the chimneys, beating down the smoke as fast as it rises. The first remedy is to raise the funnels above these

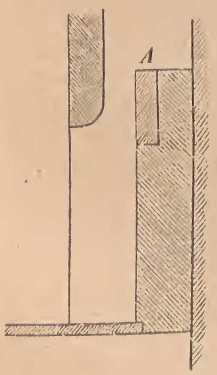
eminences; but as this cannot always be done, on account of their great height, a turncap of zinc, iron, or other metal, moving on pivots, guided by a vane, and with an opening only on one side, thus turning its back to the wind, may be applied. Day's wind-guard has four slits protected by



projecting slips. Another form now being advertised may be obtained for 10 shillings at 65, Fenchurch street. When the eminence is on the opposite side of the chimney to that from which the wind comes, the wind is, as it were, dammed up between the two, and will force itself down, no matter what be the form of the capping. Dr. Franklin mentions a city much subject to this annoyance, as most towns will be which are more or less surrounded by mountains or eminences. Cowls are creaking things, and unbearable near sleeping rooms, but they are sometimes indispensable, and are thus described in an instructive article in Chamber's Edinburgh Journal, which merits the perusal of all interested in the subject of smoky chimneys. "The simplest of all consists in the well known revolving bonnets or cowls with wind-arrows on their summits, which, by the way, were once called bishops in Scotland, while a friend assures me, that in the west of England he has heard them styled Presbyterians. The philosophy of this contrivance is sufficiently simple; in whichever direction the wind blows, the mouth of the chimney is averted from it. This principle has its development in a thousand devices, some looking like Dutch ovens come up to see the world, some like half sections of sugar loaves, some like capital H's, and sundry other pleasing objects. The red chimney pots, too, have contrivances of a similar intention in the diverging spouts and cavities and twists which some of them delight in. A different species is the perforated whirling variety, which seem perpetually whizzing round for the mere fun of the thing, since any good they do is extremely apt to escape detection. They are lively looking apparatus; but on squally nights, and when the pivots become a little rusty, the musical sounds they give forth can scarcely be considered agreeable. Among the more ingenious of smoke-curers, an invention of recent origin, named the *Archimedian screw ventilator* deserves a place. It consists, as its name implies, of wind-vanes attached to the extremity of a revolving screw. When the wind strikes these vanes, it produces a rapid revolution of the screw, which is supposed then to *wind up* the smoke or vitiated air from below. Perhaps it serves its proposed end; but whether the positive advantage thus gained is not lost by the obstruction of such an apparatus to the free passage of smoke in calm weather, is a point, in my estimation, more than questionable. For the relief of such chimneys as only smoke in windy weather, perhaps this and other forms of external apparatus are best adapted. Another invention of equal merit, is a chimney cap of metal externally grooved in a series of spiral curves up the pipe, which end in a kind of mouth-piece, from whence the smoke issues. The wind, when impelled against this apparatus, is supposed to take somewhat of the direction of the spiral grooves, and thus to form an upward current to assist in the emission of the smoke. In casting one's eye down the long streets of a smoky city, in taking a survey of the roofs and their tormented chimneys, the infinity of other contrivances is so great, that it is scarcely a poetical hyperbole to say our pen starts back from it. Here is patent upon patent, scheme after scheme, each doing its best, no doubt, to obtain the mastery over that simple thing, smoke; and each with a degree of success of a very hopeless amount. There appears to me something intensely ludicrous in these struggles against what seems to be an absurd, but an invincible foe; the very element of whose success lies in our not strangling him at his birth. Many obstacles are in the way no doubt; there are obstacles in the way of every good; but I have little doubt, that had the perverted ingenuity which has mis-spent itself upon the chimney-pots been directed to the fireplace, we might now have had a different tale to tell. The smoke nuisance is laughed at as a minor evil, by a great practical people like ourselves, who heroically make up our minds to put up with it; but when it is considered as an item in the comfort, cleanliness, and health of a whole nation, it assumes, or should assume, a different position."

4. The form of the top of the chimney may, fourthly, be mentioned as greatly influencing the passage of smoke. If highly ornamented, as in instances of some Italian, and more so in Tudor shafts clustered together, the ornaments serve as points of resistance and to reflect the wind down the flue; the wind also beating against them and stopped in its progress, rises up and passes over the openings, so that the smoke is unable to get out. In calm weather, we see the smoke rising in a column slowly curling round, but if a violent blast passes over the top of the flue, the ascensional force of the smoke is suddenly suspended, and some of the wind will impress one part of the side of the flue, and thus render impossible its free discharge. In Venice, the chimney tops are the most remarkable and striking in the world, and many of them are rounded in the true form of a funnel, the opening being somewhat of an inverted cone. The reader is referred to the diagrams before given; the example covered over is suitable for a situation commanded by higher buildings.

5. A room with no fire in it will sometimes be suddenly filled with smoke from another chimney in use. To understand this phenomenon, it must be remembered that currents of air in flues are often produced independently of the influence and action of fires. The air in a flue, being enclosed and shut up as it were, is not instantly affected by any sudden alteration in the temperature of the atmosphere without. The brickwork is a very bad conductor of heat; and thus, as the weight of the air within the channel is more or less than that without, an ascending or descending current will be formed. If the outward air be rapidly cooled, as in the evening, the air in the warm empty funnels will gradually begin to draw upwards, and this will continue till some equability is maintained. And, on the other hand, if the air outside be suddenly increased in temperature, as in the heat of the day, the operation is reversed, and the air in the chimney sets in a downward direction. In this way, smoke escaping from the tops of other flues and blown in the direction of others drawing downwards, as is most usually the case if there are no fires at their bases during the day, is, almost as a matter of necessity, drawn with the air into the apartment. And this will be more often the case, when some powerful fire, such as that in the kitchen, is in full activity, and is not independently supplied with air; for if the doors are left open, it will often derive its supply from the chimneys in apartments where there are no

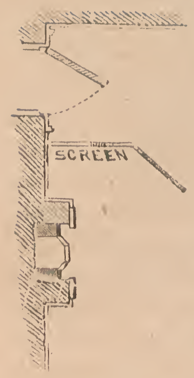


fires, and perhaps its own smoke may thus be drawn down another flue and actually returned into the room by this reciprocal action. Dr. Franklin proposed to remedy the evil by bringing down the breast of the chimney, contracting the opening, and placing an iron frame across the breast, with a plate made to slide and close up the opening, and to open more or less when a fire is required in the room. The same object is obtained by means of a register stove, or an iron conical funnel about 1′ „ 6″ or 2′ „ 6″ high, placed over the fire, and removable at pleasure. The following remarks by the ingenious Doctor will still further explain and complete our illustration of the subject. "In the summer time, when no fire is made in the chimneys, there is, nevertheless, a strong draught of air through them, continually passing upwards from about five or six o'clock in the afternoon, till eight or nine o'clock next morning, when the current begins to slacken and hesitate a little for about half an hour, and then sets as strongly down again, which it continues to do till towards five in the afternoon, then slackens and hesitates as before, going sometimes a little up, then a little down, till, in about half an hour, it gets into a steady upward current for the night, which continues till eight or nine the next day; the hours varying a little as the days lengthen or shorten, and sometimes varying from sudden changes in the weather; as, if after being long warm, it should begin to grow cold about noon, while the air

was coming down the chimney, the current will then change earlier than the usual hour, etc. This property in chimneys, I imagine, we might turn to some account, and render improper for the future the old saying; 'As useless as a chimney in summer'." A mode of converting the chimney into a cool larder during the summer season is next described, and the Doctor then enters into an explanation of the cause of the currents. "In summer time there is generally a great difference in the warmth of the air at mid-day and mid-night, and, of course, a difference of specific gravity in the air, as, the more it is warmed, the more it is rarefied. The funnel of a chimney, being for the most part surrounded by the house, is protected in a great measure from the direct action of the sun's rays, and also from the coldness of the night air. It thence preserves a middle temperature from the heat of the day and the coldness of the night. This middle temperature it communicates to the air contained in it. If the state of the outward air be cooler than that in the funnel of the chimney, it will, by being heavier, force it to rise, and go out at the top. What supplies its place from below, being warmed in its turn by the warmer funnel, is likewise forced up by the colder and weightier air below; and so the current is continued till the next day, when the sun gradually changes the state of the outward air, makes it first as warm as the funnel of the chimney can make it, (when the current begins to hesitate,) and afterwards warmer. Then, the funnel, being cooler than the air that comes into it, cools that air, makes it heavier than the outward air, — of course, it descends; and what succeeds it from above being cooled in its turn, the descending current continues till towards the evening, when it again hesitates, and changes its course, from the change of warmth in the outward air, and the nearly remaining same middle temperature in the funnel. . . . . If that part of the funnel of a chimney, which appears above the roof of a house, be pretty long, and have three of its sides exposed to the heat of the sun successively — viz., when he is in the east, in the south, and in the west, while the north side is sheltered by the building from the cool northerly winds, such a chimney will be often so heated by the sun, as to continue the draft strongly upwards through the whole twenty-four hours, and often for many days together. If the outside of such a chimney be painted black, the effect will be still greater, and the current stronger."

6. Fires often overpower one another, and thus cause chimneys to smoke. If there be two fire places in one room, and neither is properly supplied with the air requisite for combustion, the strongest fire will draw its requisite air down the flue of the weaker, thus bringing the external cold air, loaded with black smoke, into the apartment. And if, instead of being in the same, the fires are in separate rooms, one of the two will be filled with smoke drawn from the weaker flue whenever the doors communicating between the two are opened. A strong kitchen fire is thus often found to overpower every other in the house, and fill the whole place with smoke, sometimes even increased by the smoke drawn down from the chimney-tops of other houses. The case of the new house erected by a nobleman in Westminster, mentioned by Franklin, and which required £ 300 to be expended after its completion in remedying the above evil, is but a solitary example of the annoyance, trouble, and expence incurred from a want of consideration of the very simple laws which regulate the scientific arrangement of chimneys. Fires in the lower portion of a house will draw air even from the attics, and these attics often supply the deficiency by drawing smoke mixed with air from an adjoining house. The remedy for this branch of the smoke nuisance is to take care, that every fire is sufficiently and independently supplied with fresh air, so as to obviate the necessity of borrowing it from other rooms. This may be done by openings before and under the fire place, or in the side walls, as previously described.

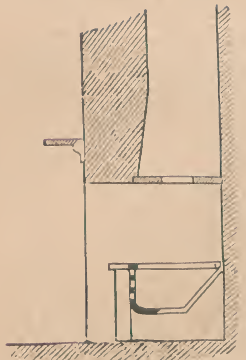
7. The relative situations of the doors and fire places will often occasion the smoke to enter rooms instead of passing off by its proper vent. The case of a chimney giving out a puff of smoke



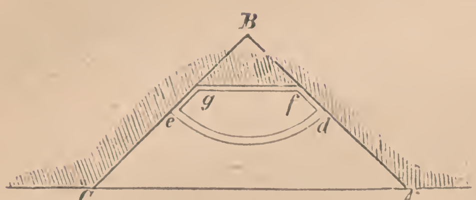
into the apartment every time a door is opened is not at all unusual, and it arises from a deficiency of proper ventilation. It occurs most frequently when the door and fireplace are on the same side of the room, and the door shuts towards the fireplace. It thus pulls out suddenly air which cannot be afforded to be withdrawn: or it destroys the regular current or equilibrium, and down the smoke comes. When again the door is opened, the air rushes in, and, passing across the fireplace opening, whisks the smoke out. It is, however, more often the case, when the door is shut, on account of the extra force of the current; and persons who are seated near the fire feel all the inconvenience of the smoke and the draught caused. The door being generally in the angle of the room and opening against the wall from the fire, one remedy is to shift the hinges, so as to open it the other way: another is to supply the fire directly with air, so that there may be a strong draught up the flue, sufficient to neutralize that caused by opening or closing doors. Contracting the mouth of the chimney and heightening the stack so that there shall be such an ascensional force as is less likely to be disturbed is also a good plan. An intervening screen will also be found useful; but altering the situation of the door will go nearer to the root of the disorder.

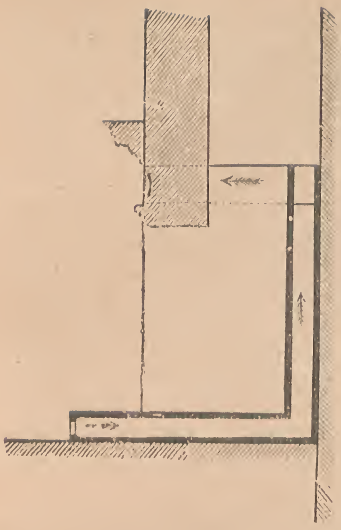
8. The form of the flue itself will materially effect the ease with which smoke can be made to pass through it. We have not much to add to what has already been said on this subject. The flue should be first carried up some distance in a perpendicular direction, by which means force is gained in the primary vertical ascent of the smoke, and it will thus be more likely to overcome any future obstacles which may be presented. There should be at least one bend before the top is reached, and attic chimneys ought to have two bends: these break the force of descending blasts of wind; and it must be evident that if the flue is perpendicular from top to bottom, no obstacle will intervene to prevent the sudden descent of the smoke; and the further down towards the fireplace the winds gets, the greater will be the difficulty in overcoming its descensional power. The bend must, therefore, be at some height above the fire, or every particle of smoke in the flue will be poured into the room by the pertinacious continuance of a gust of wind for several minutes. Again, during a storm of hail, rain, and snow, unless there are bends in the chimney, the drops will come down, perpendicularly into the fireplace, bringing down, in addition to the smoke, all the accumulated soot. Chimneys are best built in stacks, on account of the warmth generally diffused through the flues; and, for much the same reason, those enclosed in the body of a house draw better than others in external walls; and those towards the south more freely than others in the direction of the north, on account of the cooling effects of cold winds, and the liability thus induced to draw downwards, in the manner previously explained.

9. The construction of the fireplace, and the form of the grate, or stove, with which it is fitted, have great influence on the free passing away of the smoke; and setting a stove more or less backwards, or bringing it forwards, will often be found of utility. For moderate sized rooms Dr. Franklin recommended that the fireplace openings in the lower ones should be 30 inches square, and 18 inches deep; and in upper rooms 18 inches square, and not quite so deep; and those intermediate in proportion: in practice, however, they are now generally made much larger. Louis Savot, the Cardinal Polignac, and Count Rumford have made many improvements in the scientific



construction of fireplaces. The woodcut shows Count Rumford's method of constructing the throat of a chimney. *A* could be removed when the chimney required cleaning, and be easily replaced. He disapproved of the circular sidecoverings, now seen in many register stoves, considering them liable to produce eddies and currents, tending to hinder the ascent of the smoke: and he recommended the sides to be constructed of non-conducting substances, not of iron, at an angle of 135° with the back, or 45° with the front line of the fireplace. Mr. Hood, in his valuable treatise on Warming Buildings, remarks: "Although the best form for register stoves has now for several years past been adopted, the desire for novelty has caused the true principles of construction to be frequently departed from; and we accordingly find, in the most modern stoves, considerable deviations from these principles. The figure in the margin is a section of a register stove, constructed on the best possible plan for diffusing heat into the room. The sides are a right angle of 90°, *A B C*, and the bars *d e*, desribe a quadrant of a circle, whose radius is just half the length of the side *A B*. If we now wish to follow Rumford's rule of making the back one-third the width of the front, we obtain this by taking one-third of the length *A B*, which will give *B f*; and then, if we draw the line *f g*, we shall obtain exactly the required dimensions. By this arrangement it will be perceived, that the sides of the stove form an angle of 135° with the back; and all the rays of heat which fall upon these sloping sides will therefore be reflected into the room, directly in front of the stoves in straight lines. The falling cover, or register-top, should also form an angle of 135° with the back, by which means a large portion of heat will be radiated downwards into the room. These proportions, however, cannot well be adopted in stoves of a very large size, as they will be found to throw the stove rather too far back: but for all moderate sized stoves, no form can be adopted which will produce so good an effect." The construction of the sides of fireplaces and the angles at which they should be placed is of very paramount importance, and the Cardinal Polignac well remarks that, "it seems that those who have hitherto built or caused chimneys to be erected, have only taken care to contrive in the chambers certain places where wood may be burnt, without making a due reflection that the wood in burning ought to warm those chambers, and the persons, who are in them; at least, it is certain that but a very little is felt of the fire made in the ordinary chimneys, and that they might be ordered so as to send first a great deal more, only by changing the disposition of their jambs and wings." He recommended parabolic jambs, on the ground that all radii which set out from the forms of a parabola and fall upon its sides, are reflected back parallel to its axis;" while, if the sides are square, very few of the side rays from the fire are reflected into the room, in accordance with the law of the angle of incidence being equal to that of reflection. *A soufflet*, i. e. an aperture under the fire to supply it independently with air, was provided to all the Cardinal's stoves. Many ingenious contrivances have been invented for stoves by which the smoke descends at first, and in some of them the smoke itself is consumed in the fire. Dr. Franklin's *Pennsylvanian* stove is well known and he also contrived one to burn its smoke. We have already desribed, in the article on Model Cottages, Savot's me-





thod of heating two rooms by one fire, and the diagram then given illustrates this and the mode of preventing a return of smoke in the adjoining flue to that in use. The fireplace, contrived also by Savot in the "Cabinet des Livres" at the Louvre in Paris, is probably the first attempt to construct caliducts or passages below and behind the fire, in which air might circulate, become heated, and be then admitted into the apartment by means of openings above the level of the fire, thus at once serving the purposes of ventilation and warmth. In the fireplace, invented by Prince Rupert in 1678, the smoke was turned downwards into a space, behind the fireplace, before ascending the flue. We should far exceed the limits assigned us were we to enter into a more lengthened description of the varieties of grates, but we may probably, on a future occasion, treat more in detail this very extensive and important subject. We may however mention, in conclusion, that the blower will often be found an excellent remedy for smoky chimneys, although it certainly converts the fire into a furnace, and will probably send more heat up the chimney than seven eighths of the total generated, the amount which has been said to be carried off with the smoke in fireplaces of ordinary construction. It may be removable, or consist of a metal slide, supported above. In Prince Rupert's fireplace, an iron door was hung under the edge of the mantle, and extending downwards to within two inches of the upper bar of the grate. "The fire-cloth," remarks Mr. Bernan, "was a common appendage to a fire-place, particularly where wood was burned, for then the flue was large, the hearth wide and low, and the mantle high; when the chimney smoked in certain winds only, the cloth was suspended, when wanted, from each corner of the mantle-piece. But when the disease was unremitting, the curtain was fixed by rings running on a rod that went across the fireplace; when not used, it was drawn to one side, like the curtain of a cottage window; very often the fire-cloth was contrived to be drawn up like a modern Venetian blind, and made so deep, as to reach from the mantle to the hearth, and serve the office of a fire-board, when there was no fire in the yawning chimney. The first variety of smoky cloth was seldom more than fifteen inches deep, and was frequently made of painted leather; but, in good houses, the suspended fire-cloths were usually of damask and tapestry. More of these contrivances are yet extant."

10. However puzzling some individual instances of smoky chimneys may appear, we should never despair of remedying the most inveterate; and in illustration of what it has been our endeavour to prove, that the causes are invariably of an exceedingly simple character, and that to ascertain these only patience and perseverance are required, we shall cite, under this head, two cases of mysterious smoky chimneys, which puzzled the most accomplished smoke doctor, and one to whom all who have written on the subject are more indebted than to any other practitioner in this branch of pathology — the shrewd and ingenious Franklin. "I once lodged," he tells us, "in a house in London, which, in a little room, had a single chimney and funnel. The opening was very small, yet it did not keep in the smoke, and all attempts to have a fire in this room were fruitless. I could not imagine the reason; till at length, observing that the chamber over it, which had no fireplace in it, was always filled with smoke when a fire was kindled below, and the smoke came through the cracks and crevices of the wainscot, I had the wainscot taken down, and discovered that the funnel, which went up behind it, had a crack many feet in length, and wide enough to admit my arm, a breach very dangerous with regard to fire, and occasioned, probably, by an apparent irregular settling of one side of the house. The air entering this breach freely destroyed the drawing force of the funnel. The remedy would have been filling up the breach,

or rather rebuilding the funnel; but the landlord rather chose to stop up the chimney." The second instance he mentions occurred at the house of one of his friends near London. "His best room had a chimney, in which he told me he never could have a fire, for all the smoke came out into the room. I flattered myself I could easily find the cause and prescribe the cure. I opened the door, and perceived it was not want of air. I made a temporary contraction of the opening of the chimney, and found, that it was not its being too large that caused the smoke to issue. I went and looked up at the top of the chimney; its funnel was joined in the same stack with others, some of them shorter, that drew very well, and I saw nothing to prevent its doing the same. In fine, after every other examination I could think of, I was obliged to own the insufficiency of my skill. But my friend, who made no pretension to such kind of knowledge, afterwards discovered the cause himself. He got to the top of the funnel by a ladder, and looking down, found it filled with sticks and straw, cemented by earth, and lined with feathers. It seems, the house, after being built, had stood empty some years before he occupied it; and he concluded that some large birds had taken the advantage of its retired situation to make their nests there. The rubbish, considerable in quantity, being removed, and the funnel cleared, the chimney drew well, and gave satisfaction."

11. We have not space to say much respecting the construction and efficiency of the colossal chimney stacks which generally add so little to the ornamental appearance of manufacturing cities. The draught is greatly improved by conducting several flues into a large vertical one. Some of them are of great altitude, especially where it is desirable to conduct noxious vapours as far off as possible before discharging them into the atmosphere. The brick and mortar chimney stack attached to the St. Rollox chemical works at Glasgow is, we believe, with the exception of the spire at Strasbourg, the loftiest erection in Europe — its height to the cope-stone being 450 feet, with a diameter of 40 feet at the base, and $13^1/_2$ feet at the top. The following remarks by Dr. Ure comprise all that need here be said under this head. "When many flues are conducted into one chimney stack, the area of the latter should be nearly equal to the sum of areas of the former, or at least of as many of them as shall be going simultaneously. When the products of combustion from any furnace must be conducted downwards, in order to enter near the bottom of the main stack, they will not flow off until the lowest part of the channel be heated, by burning some wood shavings or straw in it; whereby the air syphon is set going. Immediately after kindling this transient fire at that spot, the orifice must be shut by which it was introduced; otherwise the draught of the furnace would be seriously impeded. But this precaution is seldom necessary in great factories, where a certain degree of heat is always maintained in the flues, or at least, should be preserved by shutting the damper plate of each separate flue, whenever its own furnaces cease to act. Some chimneys are furnished at the top with a coping of stone slabs, to secure their brickwork against the infiltration of rains, and they should be furnished with metallic conducting-rods, to protect them from explosions of lightning."

We think we have now laid before the reader, under the respective sections, almost all that is absolutely essential to be known of the several causes and remedies of the nuisances too well appreciated under the dubious and double-meaning title of a "smoky chimney." The chief authorities whose works we have consulted are Dr. Franklin's letters, more particularly that addressed to Dr. John Ingenhaus at Vienna, and which first appeared in the transactions of the American Philosophical Society in 1785; Mr. Charles Tomlinson's interesting compendium on Warming and Ventilation; Mr. Bernan's work on the same subjects; Mr. Hood's treatise on Warming Buildings; Dr. Ure's Dictionary of Arts, Manufactures, etc., and the other sources mentioned in the text.

DESIGN FOR A FIRST CLASS TAVERN.

PLATES 40. 41. 42.

Plates 40. 41. 42. contain Plans, Elevations, and Sections for a First Class Tavern. It is adapted for a principal Frontage of 48 feet, with a side Frontage of 49 feet 6 inches. Although the Design has been considered with reference to the side being at the angle formed by two streets, yet, on reference to the Drawing, it will be perceived that the plans may be easily modified to suit a situation with houses on both sides, the side Entrance being omitted, and the Windows transferred to the rear Wall. Of course an angular situation with a Yard is preferable, offering as it does opportunities for subsequent additions, and securing the convenience, if desired, of a rear Entrance, as well as facilities for the formation of Stables and out-buildings. Loudon calls "inns of every kind, the result of high civilization and the consequent intercourse of society." We have termed the design given a Tavern; but the words tavern, inn, public house, etc. do not appear to have any defined and very precise distinctive limits, nor have we been able to gather much information on this subject. The ambiguity is not confined to this country. In Webster's American dictionary, a Tavern is defined "as a house licensed to sell liquors in small quantities, to be drunk on the spot. In some of the United States, Tavern is synonomous with inn or hotel, and denotes a house for the entertainment of travellers, as well as for the sale of liquors, licensed for that purpose. Taverners are by law to be provided with suitable beds, for their guests, and with fodder for horses and cattle." On the continent, houses of a similar character are termed hotels, restaurants, and cafés, etc. English dictionaries are not very definite on the subject. In one a Tavern is called "a house where wine is sold and drinkers are entertained," and an Inn "an abode, a sojourning place," and these explanations convey a vague but tolerably correct idea of what differences may exist. The words are very old. In our version of the Testament, Luke says (chap. II, v. 7,) "they laid Jesus in a manger because there was no room for them in the inn." So Spencer,

> "Now day is spent,
> Therefore with me you may take up your inn."

Shakspere too makes Falstaff say, "Shall I not take mine ease in mine inn;" and Swift wisely observes: "To reform the vices of the town, all Taverns and Alehouses should be obliged to dismiss their company by twelve at night, and no woman suffered to enter any Tavern or Alehouse." The word Gin-palace is of modern days, and, of course, arose from the palatial character, given to many taverns; it is used as an ironical term of reproach by the opponents of these establishments. We should, however, like to see architectural decoration not quite so restricted to this branch of trade, for the like amount of capital expended on shops of other descriptions, would be found to increase their attractions; a tolerable amount of ornamentation has been bestowed on the elevation of the example given, and the style adapted is that which is generally demanded.

The accomodation comprises, on the Basement, ample Cellarage, reached by Steps under the principal Staircase, and conveniently placed for access: the cellar flap may be either in the floor of the public Bar, or at the side Entrance. There is nothing very peculiar about the fittings of Cellars; they are to be paved with brick, or stone, and vaulted over in brickwork, as indicated. Small grated openings are to be arranged for ventilation, and every means taken to preserve that equability of temperature so desirable to be maintained. For wines, cast iron Bins are sometimes used, but they are not found practically so appropriate as those formed of bricks and stone. The changes which heat and cold produce on iron have also been observed

to have an injurious influence on Port wine, rendering it muddy: for this wine of all others, is in especially affected by change of temperature.

On the ground or principal floor are provided

A Parlor	14′ „ 3″ × 14′ „ 3″
A Tap Room	14′ „ 3″ × 10′ „ 6″
A Bar Parlor (with store Closets) .	15′ „ 0″ × 14′ „ 3″
A Kitchen (exclusive of Recess) .	15′ „ 0″ × 14′ „ 3″
A Scullery	10′ „ 0″ × 8′ „ 6″

A Bar centrally situated, with doors leading to Bar Parlor and Kitchen; an opening towards the Staircase, proper fittings, and Public, Private, and Side Bars, for the casual customers, orders, and the regular frequenters of the House. A Pantry and Larder, and Closets for cleaning glasses, etc., are also provided. Behind the Building are private and public yards separated from one another, and commodiously placed for access, with a door communicating between the two: Water-closets and Urinals are arranged with a covered way leading to them. The Staircase is spacious, well lit, and so placed as to present itself at once to the eye; but before proceeding upstairs, we will offer a few observations on the fittings of the rooms above named.

The situation of the Bar is of the highest importance, and one of the first matters for consideration. It must present itself at once to the eye of the customers on entering the house, for all inquiries are addressed here; and it must command, on all sides, by means of Openings or sliding Sashes, the external door; so that it may not be possible for any person to enter or leave the house without observation. Looking-glasses properly disposed, will assist towards enabling the barmaid to see every thing passing around her. The Bar should also communicate immediately with the Bar Parlor, and be near to the Kitchen, that the Landlord or Taverner may readily step into it, and all orders for refreshments, connected with the kitchen department, be at once delivered to its inmates. It is desirable that small openings should be so placed fronting the Staircase, and all other sources of orders, that it may not be necessary for the waiter to go to the front of the bar, disturbing those who happen to be standing there. Arrangements of this description will tend greatly to facilitate that order and despatch so desirable to be maintained. The manufacture and supply of Bar requisites is a distinct trade, and the expense, which is sometimes incurred in providing Bars with elaborate fittings, rich veined mahogany carving, brass and pewter work, and decorative painting and gilding, is very great; £ 2000 and upwards are sometimes spent in this manner. A mahogany stand for glasses often costs £ 50 or £ 100, and £ 3 „ 10 „ is an ordinary cost for each pull on the Counter. Pewter is a very dear article and the brass work is also expensive. A force pump is requisite to force the liquors from the Cellars, but the casks may be supplied either from above or below, as most convenient. The Cellar is however unquestionably the most appropriate place for the stores. The pipes are connected with the casks by means of union joints, generally of brass, but pewter cocks are preferable, as less liable to corrode. A small stove for the supply of hot water, together with a fitter, ought always to be placed in the Bar, thus saving the trouble of going backwards and forwards to the Kitchen or Parlor. The Counter should be always covered with pewter, as most cleanly and best adapted, of all materials, for the required purpose. The front of the counter may be made ornamental. The inner side to have an open space for glasses, a small sink, etc. Tills, separated for gold, silver, and copper, are to be arranged so as to be most readily accessible, with the least possible trouble and waste of time. Circular counters are necessarily considerably more expensive than those which are straight, but they are often the more convenient of the two. A sufficient space should be left behind the counter to allow of the free motion of the barmaid, without running any risk of sweeping down bottles and glasses. There should be several modes of access to the bar; one for

the regular parlor or coffee room customers: another towards the public bar, with as large a space as may be demanded for the casual frequenters of the house to remain at their leisure, and a fixed bench provided, and one or more private divisions for orders, etc., separated by a slight screen from the public bar: a door placed in this partition will facilitate communication, and flaps on the counter hung on hinges, should also be provided with the same object.

On the Parlors a certain amount of decoration is often lavished; and their size will, of course, be regulated by the amount of the custom of the establishment. They should communicate readily with the outward entrance and the bar; and the seats and tables are better fixed to the flooring with two or three chairs to move near the fire; these latter are, however, better omitted; as if so, no person is then enabled to engross the fire to himself, and disturb that perfect equality which ought to prevail. The seats and tables in the Tap-room must be invariably fixed, and the room should be lined with wainscotting about 5 or 6 feet in height. The fire-place is to be fitted for cooking operations, with an oven, gridiron, and boiler. The tap-room should be as separate as possible from the rest of the house, that the noise and confusion which sometimes prevail in it may not disturb the other customers; but it should not be possible for any person to enter or leave the tap-room without passing within view of the bar, and, if possible, a separate entrance is preferable.

The Tap-room is, by no means, a necessary adjunct to a Tavern: in the design given it may be omitted and its place occupied by another parlor, or it may be placed in the yard; a little modification of the arrangements in the latter being then essential.

The Kitchen offices are to be kept as distinct as possible from the public part of the house, und to be so placed as to be conveniently accessible to the proprietor: in the design submitted, a door by the staircase effectually separates them, the Kitchen communicates with the Scullery, which latter leads into the yard. The fittings will be of the ordinary description, the Larder or Pantry and the Closet for glasses, etc., adjoin the kitchen and bar, and the glasses may be thus readily transferred to the latter.

There should be two Yards; one private, attached to the kitchen offices with a Water-closet; the other for the public, with a covered way leading to two or more water-closets and urinals: the latter are best of slate. A door should communicate between the two yards that it may not be necessary to go round the house to get from one to the other; and the entrance to the public yard should be so placed that those who are unaccustomed to the house may have no difficulty in finding their way out; but there should be no external entrance—at least if there is one, it ought to be kept locked—otherwise it would be possible for any one to enter or leave the house without the knowledge of the Landlord.

The Staircase leading to the upper rooms presents itself readily to view, and is well lighted and easily accessible; and all this should be more particularly the case when the upper apartments are destined for public purposes. The first floor plan comprises

A Club Room or apartment for Public Meetings .	44′ „ 9″ × 21′ „ 0″
A Coffee Room	14′ „ 3″ × 10′ „ 6″
A Billiard Room	15′ „ 0″ × 14′ „ 3″

A Closet for stores or for waiter, and Water-closet.

A large Room for public meetings, and to be used also as a Club Room, for dinners, suppers, etc., is an absolute requisite in a first class Tavern. It may also be used as a dining room if the business of providing dinners, *à la carte,* at all hours during the day be combined with the main purpose of the establishment. This apartment will be decorated in a manner commensurate with the importance of the house. The Club room in our design is a fine apartment, well proportioned, and amply lighted, and commanding, from its windows, views at the front and side. The walls may be stuccoed and painted, in party colors; a handsome cornice, with enrichments, run round the ceiling which is divided into panels, in the centres of which pateræ are to be placed and

chandeliers suspended from the middle. A dado surrounds the room; and on this and the wood-work to the windows and doors are to be grained some light woods: handsome marble chimney-pieces to be provided.

A Coffee Room for the better class of customers is necessary; and this is often apportioned by means of slight screens, into divisions; with fixed tables and seats: if this be done the size of the room must be proportionately increased. The aspect of the Billiard Room is of no great consequence, those in it being presumed to be engaged in the game; but the light is of importance. A Water-closet is desirable on this floor; and the waiter's closet is conveniently placed with respect to the Club and Coffee Rooms.

On the second floor are —

A private Sitting Room		15′ „ 0″ × 15′ „ 0″
A Bed Room		14′ „ 6″ × 10′ „ 6″
A Dressing Room		10′ „ 6″ × 6 „ 0″
A Bed Room (with large closet)		15′ „ 0″ × 14′ „ 0″
Ditto	Ditto	17′ „ 6″ × 15′ „ 0″
Ditto	Ditto	15′ „ 0″ × 14′ „ 3″
Ditto	Ditto	10′ „ 0″ × 7′ „ 6″

A Linen Closet and Water-closet.

It is always desirable, to provide a Sitting Room for the proprietor and his family, in addition to the Bar Parlor, the latter being appropriated to business purposes. This Sitting Room is best placed upstairs, beyond the reach of the frequenters of the house; this is done in our design; and the room is a very cheerful one, commanding views in two directions. The number of Bed Rooms will necessarily be limited by the size of the family; and the circumstance of whether or not any of them are proposed to be occupied by Travellers is also to be taken into consideration. If this be proposed, another story may be added to the design submitted with the greatest facility, without at all interfering with the arrangements already described and the character of the elevations; the topmost story being an exact repetition of the present upper one; the cornice, of course, raised; or attic windows may be placed behind the cornice and attic. One of the Bed Rooms has a Dressing Room adjoining; a water-closet is necessary on this floor; and it is provided, lighted, and ventilated above, together with a closet for linen or other purposes. Ample additional closets, always convenient accessaries, are also given. A proper arrangement of bells, all conducted to the Passage adjoining the Kitchen and Bar, is an important consideration.

Inns or Taverns of recreation include gardens, with summer-houses, fountains, etc., often laid out with much taste. Swings, Skittle-grounds, and Bowling-greens are commonly provided. The skittle-ground should be hard, smooth and perfectly level; this desideratum may be obtained by means of a composition of quick lime, sharp sand, and, smithy ashes spread over a layer of small stones, or coarse gravel. The bowling-green should be well drained, with gratings comunicating with underground drains running along the sides. The surface of the ground must be reduced to a perfect level, and rammed to a uniform degree of solidity, after which it is to be covered with turf, well watered and rolled; the grass being kept neatly cut, so as to present a surface of perfect evenness. A Gutter, one foot broad and about 4 inches deep, is to run all round the margin: this communicates at intervals with the drains. A good bowling-green should thus present a dry surface almost immediately after showers.

Taverns and Inns should always be constructed fire proof; the necessity for their being so is obvious. All the partitions should be of brickwork, and the staircases of stone. The floors may be formed of brick arches turned $4^1/_2$″ to 9″ thick from cast iron girders 5 or 6 feet apart: the small girders or joists rest on larger beams, either of cast or wrought iron; the latter is far preferable; and hollow bricks are more suitable for the arches than those which are solid. Joists

are laid on these arches with wood flooring. The method patented by Fox and Barret is also excellent. It will be described under the head of Fire-proof construction and it is sufficient here to name the relative costs estimated by the Patentees.

	Per Square.
Common Timber Floor . .	£ 5 „ 6 „ 0
Superior Ditto	£ 7 „ 2 „ 0
Fox and Barret's Fire-proof Cement surface	£ 5 „ 19 „ 0
Inch boards	£ 7 „ 2 „ 0
Inch $^1/_4$	£ 7 „ 9 „ 0

It is hardly needful, to insist on the necessity of an efficient system of ventilation in taverns, especially in rooms where smoking is permitted. There should be always two sets of openings, one for the admission of fresh air; another for the escape of that which is vitiated; in the article on Ventilation full particulars will be found.

The Design given can be erected of stock bricks with Roman cement dressing, and fir timber, for £ 2,800, exclusive of the Bar fittings; these may be set down at £ 150 or £ 200 of a handsome character, £ 3,000 may therefore be calculated upon as the sum requisite to fit up the Establishment completely.

DESIGN FOR A SMALL VILLA.

PLATES 43. 44.

This Villa is adapted for a frontage of 30 feet, and would be conveniently placed at the angle of a road, which position is always preferable on account of its more commanding position, the extra light and prospect gained on one side, and the means of communication afforded at the back of the house. The house is suitable for a small family, comprising as it does the following amount of accomodation.

On the Ground Floor an Entrance Passage, leading into a well-lighted Hall, with Staircase rising out of it to the upper floors: a door communicates with a passage leading to the Kitchen Offices and to the Garden; a *W. C.* and also a stove-closet, are placed under the staircase.

The rooms on this floor are, —

A Drawing Room	14′ „ 0″ × 10′ „ 6″
A Dining Room	14′ „ 0″ × 10′ „ 6″
A Kitchen	10′ „ 6″ × 10′ „ 6″ exclusive of recess.

Kitchen, Closet, Coal Cellar, and Pantry.

On the Fist Floor are, —

Two Front Bed Rooms, each	14′ „ 0″ × 10′ „ 6″
A Dressing Room	10′ „ 0″ × 5′ „ 3″
A Back Bed Room	10′ „ 6″ × 10′ „ 6″

W. C. and Linen Closets.

On the Attic Floor are Bed-rooms similar to those on the First Floor, together with two Closets.

The Ground Floor is elevated 2′ „ 3″ above the ground level, and is 10′ „ 6″ in height, the First Floor is 9′ „ 0″ high, and the Attic Floor, 7′ „ 0″ high.

The elevations are of an Italian character, and the dormer windows lighting the Attics are converted into ornamental features giving a picturesque effect to the roof.

The materials proposed to be used in the construction, are fully described in the following Specification. — They will be found generally applicable in most districts in the United Kingdom, but can of course be altered, according to the peculiar products of the locality in which it may be proposed to erect the house; our Specifications are varied, and where one is not appropriate in all respects, another will be found to be so in the respective particulars. The cost of the house, if built in accordance with the Specification, will be within £ 650.

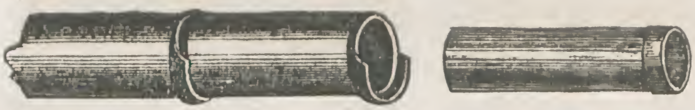
SPECIFICATION OF THE CONSTRUCTION AND FITTINGS.

EXCAVATOR.

THE GROUND is to be dug to the necessary depth and width for the walls, drains, etc., and to be filled in and thoroughly rammed as the several works are brought up. The concrete under the walls is to be 1 foot deep, and twice the width of the lowest course of footings. It is to be composed of four measures of broken stones, two of sand, and one of lime; the latter is to be slacked upon and in immediate contact with the stones and sand, and to be tipped over from the harrow at the lowest possible level.

BRICKLAYER.

THE BRICKS used are to be sound, hard, well burnt stock bricks, of a regular size and shape, those used externally to be selected of the most uniform colour. The mortar is to be composed of two parts of the best and sharpest sand to be procured in the neighbourhood, one part of good stone lime, the whole thoroughly mixed and incorporated together. The Drains are to be of glazed stoneware (Millichams, as in margin): to be laid to a fall of 1 inch in 10 feet, with all requisite bends, junctions, etc., and to be properly connected with sewer; that from the sink, to be 4 inches diameter, and from *W. C.* 5 inches; they are to be jointed in cement. The Walls are to be carried up of the dimensions and in the manner indicated on the engravings. They are to be built in regular courses, *English* bond, 4,352 bricks to a rod, or four courses kept one foot high. The walls to be neatly cut to take timbers of roofs as well as to all skew backs. Build fender and sleeper walls and all trimmers and footings very carefully; the bottom courses of the latter to be invariably double. Build up the columns carefully in cement of rounded bricks; turn arches, 9 inches thick in double rings, bonded with a whole brick, where the joints meet, to be semi-circular and otherwise as shown; a semi-elliptical arch over opening into hall; turn also $4^1/_2''$ arches over fire-place openings, and 9 inch arches over all other openings. The flues to be $14'' \times 9''$, well cored and pargetted. Pave the coal cellar with hard stocks laid on edge in sand and grounded on a bed of hard dry rubbish and lime. The copper is to be neatly set in brickwork; the sink let into it at one end, and a $4^1/_2''$ wall carried up to support the other extremity. The whole of the internal partitions are to be bricknogged. The exterior pointing to be executed with a neat, close, flat joint. Bed and point all door and window frames; carry out all corbelling courses; fill in putlog holes with matched bricks; bed all wall plates and lintels; cut all requisite chases; in footings use only whole bricks, and not less than half bricks anywhere; provide 16 air bricks to be used where pointed out; and lay a coat of Claridge's Seyssel asphalt, $^3/_8''$ thick over the surface of the walls, 18 inches above the ground level, to prevent damp rising.



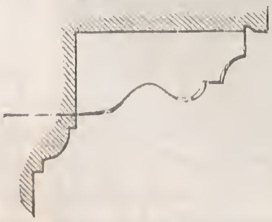
MASON.

The steps at Front Entrance to be of Portland stone, moulded on the face as shown; the bottom one to be solid, and the others to rest on the side walls; they are all to be back rebated. The Landing to be 4″ Portland stone landing moulded and rubbed; it is to be cut and pinned into side walls. The Step to back entrance to be of Yorkshire stone, tooled on the face, 9 inches wider than opening, pinned into walls, and with rounded ends. Provide all requisite cores to cornices, etc. Rubbed Portland slabs 2 inches thick, and 18 inches wider than openings, and tooled York inner hearths 2″ thick to fire-places; the outer slabs to kitchen, and attic bed-rooms, to be of rubbed York. The Chimney-pieces to sitting rooms to be of marble, of the P. C. value of £ 4 „ 0 „ 0 each; those to bed-rooms, first floor, boxed and moulded of Portland stone, and the remainder $1\frac{1}{4}''$ Portland jambs, mantles, and shelves 6″ wide. The Sink to be of York stone, 6 inches thick, and 3 inches deep, of the size and shape shown, perforated for a 4 inch bell trap.

CARPENTER AND JOINER.

The Oak is to be of English growth: the yellow Fir to be the best Dantzic, Riga, or Memel. No American, Swedish, or Scotch fir to be introduced. The floors and joiner's work are to be of the best Christiania deals. The timbers and deals are to be of the first quality, entirely free from sap wood, cut square, and with no shakes, large knots, and other defects. If any parts shrink, and fly within eighteen months of the fixing, the contractor is to take down and make good the same, at his own expense. The joists, quarters, and rafters, are not to exceed 14 inches from centre to centre, excepting the rafters to principal roof. — The contractor is to provide, fix, ease, and strike, all centering and turning pieces for arches, trimmers, and other works, to fix all necessary templates, linings, blocks, casings, beads, fillets, angle-staves, grounds, backings, furrings, cappings, and all other finishings, incident to carpenter's and joiner's work, together with all necessary grooving, rebating, tonguing, framing, housing, beading, mitring, etc., for properly finishing the works. Wood bricks are to be provided and fixed; also all lintels of the width of the brickwork, 4 inches deep and 18 inches wider than the openings. Herring bone strutting $3'' \times 1\frac{1}{2}''$ between joists on first and second floors wherever the bearing exceeds 8 feet.

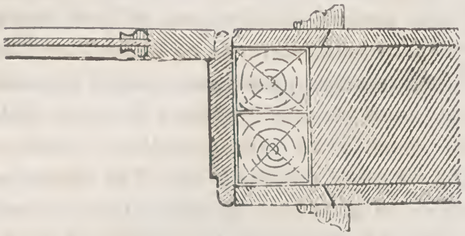
The roof is to be framed together in the manner indicated on the section. The hips and ridges are to be $10'' \times 2''$, rounded for zinc; the main rafters $6'' \times 2\frac{1}{2}''$, 2 feet from centre to centre; smaller rafters to dormers, $4'' \times 2''$; collars, well spiked with oak and lapped on rafters, continuing to form ridges to dormers, $6'' \times 2\frac{1}{2}''$; a piece of timber resting on walls and carrying ridge $9'' \times 4''$; and another at head of partition of the same scantling, carrying rafter and supporting collar on one side; plates $4'' \times 4''$ lapped and spiked with oak at the angles.



Wood blocks of the profile given in the margin, are to be firmly fixed to carry projecting eaves, formed with inch yellow deal, wrought, ploughed, tongued, and grooved fascia 9″ wide and soffite projecting 2 feet from the face of wall. The lean-to roof to have rafters $4'' \times 2''$; plates $4'' \times 3''$; the upper one secured to wall by iron brackets; and inch yellow deal boarding, close-jointed, and nailed with eight-penny nails.

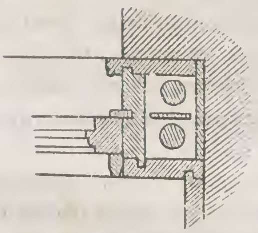
The joists on ground floor to be of oak $3\frac{1}{2}'' \times 2\frac{1}{2}''$, with oak plates $3\frac{1}{2}'' \times 3''$. Those on first and second floors to be of yellow fir $8'' \times 2\frac{1}{2}''$ with fir plates $4'' \times 3\frac{1}{2}''$. The floors to sitting rooms, hall, and entrance passage to be inch $\frac{1}{4}$ yellow deal, batten floors, straight joint, edges nailed, splayed heatings, and mitred borders to slabs, those kitchen, passage, pantry, and closet, to be of inch $\frac{1}{4}$ yellow deal, wrought and laid folding, that on first floor to be inch $\frac{1}{4}$ yellow deal, straight joint, and splayed headings; and on attic floor, inch white deal, wrought

and laid folding. — The doors to Drawing and Dining Rooms to be 2 inches thick, moulded and hung on $3^{1}/_{2}''$ brass butts to $1^{1}/_{4}''$ double rebated and double rounded linings; inch framed grounds 6 inches wide and moulded architrave 4 inches girt.

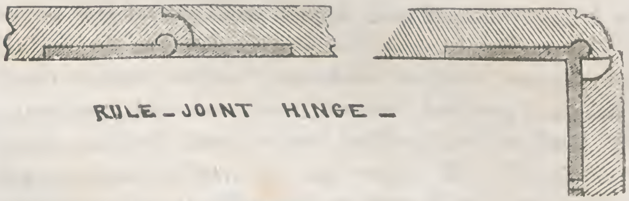


The Hall door and that to W. C. to be similar but $1^{1}/_{2}''$ thick, moulded and square, with architrave and grounds on one side only. — The remaining internal doors to be $1^{1}/_{4}''$ square, hung on $4''$ wrought iron butts to inch $^{1}/_{4}$ single rebated and double rounded linings. The front entrance door to be $2^{1}/_{2}''$ thick, bolection, moulded on one side and bead flush, the other hung on $4^{1}/_{2}''$ wrought iron butts to wrought, framed, rebated, ploughed, and twice beaded door frame $4^{1}/_{2}''$ square, fixed to floor with wrought iron dowels, and to have transom $4^{1}/_{2}'' \times 5''$ double rebated, four times beaded and framed into posts, a continuous head is to be fixed over, as indicated, beaded and rebated to correspond, and fillet in with $2''$ beaded sash hung on brass sash-centres and fastened with a small brass button; $^{3}/_{4}''$ tongued lining, rounded at outer edge inside; oak rounded step and riser. The back entrance door to be 2 inch bead, butt both sides hung on $4''$ wrought butts to wrought, rebated, and beaded frame, $4^{1}/_{2}'' \times 4''$; transom, double, rebated, and beaded $4^{1}/_{2}'' \times 3''$, and sash on centres $1^{1}/_{2}''$ thick; oak rounded step and riser. The doors on first floor to be $1^{1}/_{2}''$ moulded, hung on $3^{1}/_{2}''$ butts to inch $^{1}/_{4}$ single rebated linings; inch framed grounds $4^{1}/_{2}''$ wide, and ogee moulding run round. These latter omitted to inner side of linen closet door, the inner panels of which are also to be square. The doors on second or attic floor, to be $1^{1}/_{4}''$ square doors, hung on $3''$ butts to inch, single, rebated, and double rounded linings.

The windows (excepting those to domers) to have all lifting ovolo sashes of inch $^{1}/_{2}$ deal, with circular heads where shown. Deal cased frames (as in margin) oak sunk sills, $^{3}/_{4}''$ outside and inside linings, inch wainscot pulley pieces, and parting beads, inch soffites $^{1}/_{2}''$ inside linings, sash lines and every requisite complete.



The dining and drawing room windows to have inch $^{1}/_{4}$ 4 panel, bead butt and square front shutters, on splay, and square back flaps; the front shutters to be hung on $3''$ brass butts, the back on $2''$ flap hinges. Inch one panel bead butt back linings tongued to frame; inch $^{1}/_{4}$ proper boxings, moulded architraves to correspond with those to doors, and $^{1}/_{2}''$ narrow return beaded linings. Inch $^{1}/_{4}$ — 1 panel bead butt soffite; inch narrow plain backs and elbows, beaded cappings and elbow cappings. The kitchen window to have inch $^{1}/_{4}$ 2 panel bead butt and square shutters and rule joint hanging stiles hung on $3''$ butts and strong rule joint hinges, and with a wood latch shutter bar.



RULE-JOINT HINGE —

Inch tongued and rounded linings on splay, and inch $^{1}/_{4}$ rounded window board. The remaining windows are to be finished with similar linings and boards on splay where so shown; but the small windows are to have inch chamfered sashes hung on centres with cut beads and fastened with small bolts; beaded frames $4'' \times 4''$; no linings to those in $9''$ walls but tongued beads at bottom inside. The dormer windows are to have chamfered casement sashes hung on $3^{1}/_{2}''$ wrought butts, with turnbuckles, water-bars and stay hooks. These dormers are to be framed together with inch $^{1}/_{2}$ deal, cut and moulded in the manner indicated; the sill pieces to be of oak, and the moulded capping to be securely fixed.

The Staircase is to be constructed with strong carriages, inch $^{1}/_{4}$ yellow deal steps and risers tongued together. Inch $^{1}/_{4}$ moulded wall string, and inch $^{1}/_{4}$ sunk, and moulded string board,

both ramped and kneed so as to be one uniform height, above the steps; $^3/_4''$ beaded apron lining, curtail end to starting steps, all firmly bracketted, glued and blocked, with every requisite complete. — Honduras mahogany moulded handrail, $4'' \times 3$ properly ramped and kneed, with scroll and twist at bottom; turned newel $2^1/_2''$ diameter, and deal square, bar balusters, dovetailed; every sixth and seventh to be of wrought iron, properly secured above and below. The water closet to have $1^1/_4''$ deal seat and riser, clamped flap hung, on $2''$ brass butts, beaded frame, square narrow skirting and all requisite bearers, pipe casing, etc. — The cistern above upper closet to be of its full internal size, framed of inch $^1/_2$ deal dovetailed, with wrought iron bolt complete; a door must be fixed above to get at the cistern, to be finished externally similar to the one below, and hung on $2''$ butts, with small flush bolt fastening. The cistern to closet on ground floor, to be fixed so as to allow access to it from below, and to be similar to the other: strong bearers to carry both.

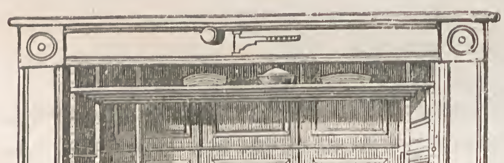
The dwarf-closets in Dining room to be of inch deal, moulded in front, with square skirting at tops, the doors hung with $2^1/_2''$ brass butts and to have tumbler locks. The closets in bed room to be similar, with closet locks.

The Sitting rooms, Hall, and Entrance passage, to have moulded and sunk skirtings 12 inches high; the kitchen, offices, W. C., and passage, square skirtings 6 inches high, together with the attic floor; the first floor rooms to have moulded skirting, 9 inches high, and the closets square skirtings 6 inches high.

Provide and fix a dresser, fitted complete in kitchen, shelves in pantry, cover to copper, and all other incidental fittings.

SMITH AND IRONMONGER.

Wrought iron chimney bars $2^1/_2''$ wide and $^1/_2''$ thick to chimney openings. $^1/_2$ Inch wrought iron bolts, with nuts, washers and screws to cistern. $^3/_4$ Inch wrought iron balusters to staircase properly rivetted and fixed. 16 Cast iron air bricks. In addition to the ironmongery already described, provide to entrance door 9 inch drawback, brass-mounted lock, with iron chain, and barrel, and two 8 inch bright rod bolts. The back door to have a six inch iron rim, two bolts, knob lock, and two 8 inch rough rod bolts. The sitting room doors and those to bed and dressing rooms on first floor are to have $7''$ mortice locks; the sitting rooms to have a mortice set of white China furniture, and the rooms on first floor ebony furniture; the closets on the latter, and W. C. below, together with hall door, to have finger plates only on one side, and the W. Cs. to have brass W. C. latches. The remaining doors to have 6 inch iron rim two bolt knob locks. The lifting sashes to have brass cased pullies, cast iron weights and brass sash fastenings. The bell handles and shutter knobs to correspond with the furniture of the rooms; each window in sitting rooms to have an iron spring bow shutter bar. Iron bars are to oe securely fixed outside hall window.

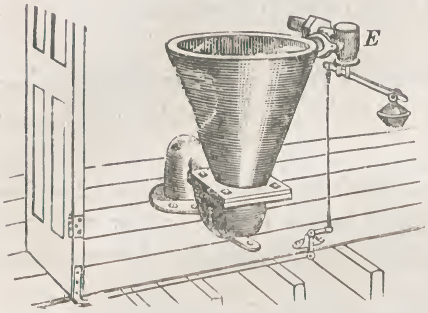


Provide register stoves to sitting and bed rooms on first floor, ordinary grates to attics, grate to copper and Dudley's (Northampton) cooking stove sn kitschen. But also in hall, one of Carman's smokeless stoves which may be procured for the sum of 12 shillings.

ZINC WORKER.

Cover the main roof with Italian formed Zinc, properly reveted and laid in the manner illustrated in margin. No. 15 of the Vieille Montagne Zinc to be used; no other is to be depended upon. Ogee gutters of No. 14 Zinc, and 4 inch down pipes of the same number. Properly dress zinc, and flash round chimneys and sides and sills of dormers.

PLUMBER.



Line the cisterns with lead, 7 lbs. to the bottoms and 6 to the sides. The upper one is to be supplied by $1^1/_4''$ rising main, and an inch service pipe is to convey the water to the lower cistern, and from this, another inch supply pipe is to be led to the sink. The lower cistern to be provided with inch brass cock and copper ball, and inch $^1/_4$ waste pipe delivering into trap of W. C. Each closet to have $^3/_4$ service pipe and 4″ lead soil pipe delivering into drain. Lambert's (Lambeth) DOOR ACTION closet apparatus of enammelled iron (an ingenious contrivance) to be provided and fixed. The sink to have inch square way cock, 4″ brass grate and bell trap, and $2^1/_2''$ waste pipe delivering into drain.

PLASTERER.

Render, float and set, for paper, the whole of the internal walls, excepting those to the Kitchen offices, which are to be limewhited twice, and lath, plaster, float and set the ceilings; those in sitting rooms to be distempered by the painter, and the remainder whited; the underside of lean-to roof to be twice limewhited. Cornices 9 inches girt to be run on chamber floor, excepting only the closet and the Hall and Entrance passage. To Drawing and Dining rooms, run cornices 16 inches girt with one enrichment 4″ girt *papier mâché;* also a centre flower 2′ 6″ diameter to each room, also in *papier mâché* secured to the ceiling.

The exterior to be stuccoed in the best manner with Portland cement, 3 parts sand to 1 cement, jointed to imitate masonry, and to be coloured with weather proof colouring, fixed with tallow, beergrounds, tar, and other proper ingredients.

PAINTER.

Knot with silver leaf, pumice down, smooth and otherwise prepare all the work intended for painting. Cover all wood work, where seen, with four coats of good oil paint. Grain the wood work to sitting rooms, hall and entrance passage, wainscot or maple, and the entrance door dark oak. The remaining work to be finished in such colours as may be directed. Distemper ceilings of sitting rooms. Apply two coats of copal varnish to all grained work.

GLAZIER.

Glaze the principal windows with the best Newcastle Crown glass, and the remainder with second crown glass, properly bedded, back puttied and left clean and perfect to the completion.

SLATER.

Cover the lean-to roof with Bangor Countess slating, nailed with composition nails, two to each slate, and laid with a $2^1/_2$ inch bond or lap; the eaves to be double. A fillet of Parker's

cement to be formed with nails to give a hold to the cement, and leave the whole complete and perfect.—No slates to be laid lengthwise.

PAPERHANGER.

Prepare and bring to a proper face the walls intended for papering, and hang the papers that will be chosen.

BELLHANGER.

Provide and fix with all necessary wires, pulls, cranks, and other appendages whatever bells may be required.

DESIGN FOR A PAIR OF SUBURBAN RESIDENCES.

PLATE 45.

Plate 45, contains Plans of the Ground and Chamber Floors and the Front Elevation of a Pair of Suburban Residences. Although these houses are proposed to be erected in pairs, it will not be difficnlt to continue them to form a row of any length; the windows lighting pantries and bed rooms being placed in the front instead of the side, and the projecting brickwork to the fireplaces brought in.

They will be found convenient dwellings for a small family, each comprising the following amount of accomodation.

On the Ground Floor:

A Drawing Room	15′ „ 0″ × 12′ „ 0″
A Dining Room	12′ „ 6″ × 10′ „ 6″
A Kitchen	16′ „ 0″ × 10′ „ 6″
A Scullery	8′ „ 6″ × 8′ „ 0″

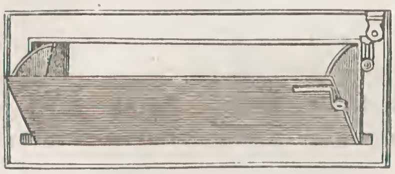
Entrance Lobby, Hall, Closet for House-maid, Pantry, W. C., and Coal Cellar, with Dust-bin outside the house.

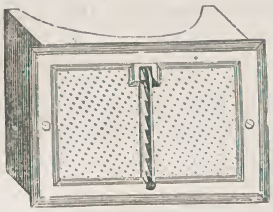
On the Chamber Floor:

A Front Bed Room	15′ „ 0″ × 12′ „ 0″
A Dressing Room	8′ „ 0″ × 5′ „ 0″
A Side Bed Room	10′ „ 6″ × 8′ „ 0″
A Back Bed Room	12′ „ 6″ × 10′ „ 6″
A Bed Room over Kitchen .	11′ „ 0″ × 10′ „ 6″

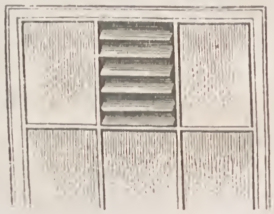
Another Bed Room may, if desired, be conveniently placed over the Scullery; the access to it being from the landing of the Staircase; a closet and W. C. being also situated in the passage leading to it. The house would then contain ten rooms in addition to the various closets, etc. The elevation is not expensive, although effective: it is an illustration of what may be done by the judicious balancing of plain surfaces; moulded work, always costly, being very slightly introduced. Stock bricks are proposed to be used; their price is now about five and twenty shillings per thousand; place bricks may be used for the partitions; these are only sixteen shillings per thousand, and consequently a great saving will be thus effected.—Kentish red bricks have certainly a very gay and cheerful effect, and they contrast well with stone and cement, but the price will often preclude their adoption; and the expense of White Suffolk Bricks counterbalances with many, their neat appearance. Yellow Malms are best for arches which show on the elevations, where the plain surfaces are of ordinary stocks.—The whole of the internal partitions are to be

bricknogged, with the exception of that over the kitchen. Bricknogged partitions will be found the cheapest, and more effectual than wood in preventing the passage of sound; the timber work will probably be preferred of fir; but on reference to the article on the different kinds of wood used in building, the reader will at once perceive which are adapted to the proposed purposes, and which are unquestionably inappropriate. The joists and plates on the ground floor ought to be of oak, although we fear that false considerations of a shortsighted economy will prevent, according to the present system of building, the general introduction, where dampness is likely to occur, of this excellent and durable material. Fir, will after all, be most likely used; charring it will do much towards the prevention of decay. — The ground floor is raised 2′ „ 3″ above the ground level, and the space beneath must be thoroughly ventilated by means of numerous cast iron air bricks, properly disposed to create a thorough current, as this will assist greatly in keeping the building dry. Concrete is to be used if needful under the walls; its proportions and the mode of application have been already described in the Specifications given of other works; if the site is very damp, spread a layer of concrete about 6 inches in thickness over the whole enclosed surface built upon; it will be found an almost infallible remedy. Of the different modes of forming damp-courses, we need not repeat anything here, as full particulars will be found in previous

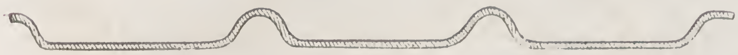




pages. A fair amount of height has been given to the apartments. Houses with low rooms are always unhealthy, more especially when unprovided with any ventilating apparatus. Why ventilators are not more extensively used has been always a puzzle to us. It cannot be on the ground of their expense; Sheringham's, shown in the margin, can be procured of plain iron for 6*s* „ 6*d*, and bronzed for 8*s* „ 6*d*. — Hart's ventilators are yet cheaper, and may be had for three or four shillings. They are always as well combined with one of Moor's moveable glass ventilators placed in the window pane, as illustrated. This will serve the purpose of admitting fresh air while the other ventilators allow of the escape. These glass ventilators are also so far a remedy for smoky chimneys as they admit air, when the smokiness arises from an insufficient supply, to the apartment. Dr. Arnott's circular valves for chimneys may be made rather ornamental in appearance; we exhibit one form which may be had, eight inches in diameter for 6*s* 6*d*.

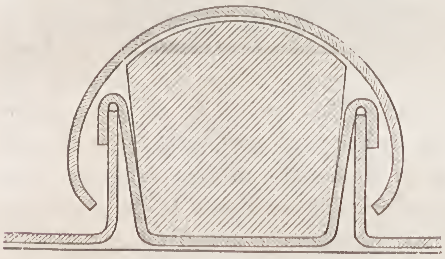


Considering the cheapness of this very simple and effective contrivance; considering above all the importance of a due supply of pure air to maintain the bodily system in a state of health and that "in twenty four hours upwards of 57 hogsheads of air are inhaled to oxygenate 24 hogsheads of blood" it is truly a wonderful example of popular apathy that, with the means of remedying the evil so readily at hand, people should be content to shut themselves up in small low apartments, in which it is impossible the air can oftentimes remain fit for respiration for one single hour. No wonder that $27^1/_2$ per cent of the deaths in this kingdom are owing to diseases, slowly contracted, of the respiratory organs; but in our article on ventilation, we shall expand on this subject. The height given to the floors of the design under description is 11 feet, and this for the size of the rooms is a good proportion. The roof is proposed to be covered with zinc, which is to be procured in sheets 7 or 8 feet long and 3 feet wide. — The advantages attending its use are the lightness and economy of the material. As we have before remarked, the Vieille Montagne zinc is the best; it is imported from Belgium. Our design shows what is called the



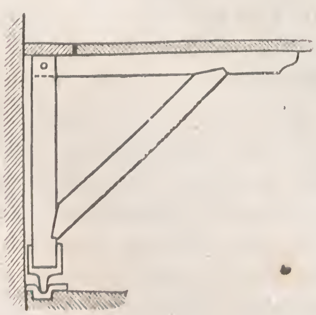
Italian roofing; there are two varieties of this, the large and the small Italian; the first having one roll and two half rolls in a sheet; the second, two rolls and two half rolls in a sheet. There is an obvious advantage attendant on the use of the small Italian, or two roll zinc; for as it is found by experience that the expansion and contraction of the metal takes place in the rolls, this is better allowed for, and is more distributed where there are two rolls instead of one, thus greatly obviating the objection which has been made to the roofing on account of its construction.

Independently of this, the small Italian roofing is more economical, for the three feet sheet measures 2′ „ 6″, after corrugation; while the one roll or large Italian, measures 2′ „ 2″. This latter may be procured of several manufacturers; but the small Italian is only to be had at Mr. Frederick Braby's manufactury in the New Road, London. The guages used may be No. 13, 14, or 15, weighing respectively 22, 23, and 24 ounces per foot super. Very little timber support is requisite, but it is desirable to have a wood roll where the sheets join.



Zinc should always be laid on the system of free dilatation, with deal rolls and zinc covering caps, in the manner illustrated, which is specially suitable for any flat roof. The roof over the Scullery is proposed to be covered with Bangor Countess slating. The total cost of the two houses will be about £800. We shall put together in a general way, under the heads of those designs for which we do not give detailed Specifications, such general remarks on the fittings, appurtenances and the planning arrangements and economy of domestic habitations as will be found useful, and we propose now to make a few observations on these subjects.

The living apartments for the family should be kept as distinct as possible from the kitchen offices, and in most of the designs we have given, they are separated by a door.—The advantage of this arrangement must be very obvious; all noises and disagreeable odour are cut off, and the comfort of both the family and the servants is increased; draughts are lessened and warmth is more readily retained. Where a door cannot, from peculiarities of plan, be conveniently used, it will be as well to establish a current of air ventilating the kitchen from the main portion of the house, and thus rendering it impossible for the smell arising from cooking and cleaning operations to enter the sitting and bed rooms.—The damp caused by the washing and drying of clothes in the kitchen or laundry, should not be allowed to rise up and enter the bedrooms, or its injurious effects on the linen will sooner or later be



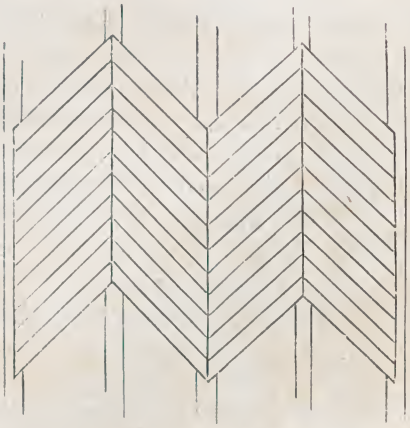
visible. The kitchen should be fitted with a dresser, (descriptions of these will be found in the Specifications), and an ironing board, fixed to the wall, hung on hinges, with supports turning on pivots

somewhat in the manner illustrated in the margin.—Of kitchen ranges there are an immense variety. That shown in the margin is registered by the Messrs. Nicolls of Dundee and is very convenient. The fire grate *A*, is fitted underneath with an ash pan *B*, below which is a heated chamber *C*, to be used for warming dishes, or keeping cooked meats hot. The upper oven *D*, which has a ventilator *E*, may be used for baking meat and the lower one *F*, may be similarly employed for pastry; on the opposite side of the fireplace is a boiler *G*, running behind the grate for supplying hot water for baths and ordinary kitchen purposes. The ovens, heated chamber and boiler are heated by the several flues *H*, running entirely round them, and serving as well to heat the plates *I*, which are serviceable where slow boiling is required. The arrangements altogether are of the most compact which we have seen.

The Scullery should be fitted with a sink, with plate rack above; a copper, and an oven for baking bread will be found useful; the construction of the latter is described in the Specification to the Model Cottages. The Scullery is best paved, either with bricks, flat or on edge, or with Yorkshire stone; brick flat paving is generally the cheapest; of course if the bricks are laid on edge, the paving is more expensive, but decidedly better; there should be a fall in the paving that the water used while scrubbing it may run in one direction, whence it should be drained off. The kitchen is preferable boarded, from considerations of personal comfort. A back door ought always to be provided from the scullery; and the dust-bin should be kept covered over; a wood cover hung on hinges is desirable, with an opening at the bottom of the bin closed by a door. The pantry must be well ventilated; the air being admitted below by means of cast iron air bricks, and a portion of the window fitted with perforated zinc. The air bricks may be made ornamental on the exterior face. Two small windows to the pantry are preferable, that a current may be promoted, The shelves may be of wood, or of slate slabs rubbed, and the door panels be partly filled in with perforated zinc. The coal cellar is best paved; brick paving is suitable. The Water Closets must be well ventilated, and their fittings are described in the Specifications. If a vase is placed in the Water Closet, filled with concentrated muriatic acid, so that its surface is in free communication with the vapours issuing from below, the carbonate of ammonia combining with the muriatic acid, all unpleasantness is obviated, and the closet rendered as healthy as any other room. The fittings to the Drawing and Dining Rooms will be varied according to the tastes of the occupants; and of Bed rooms we need only observe that they should be lofty and well ventilated, as the number of hours for which they are kept closed, while in occupation, renders their airiness a matter for consideration. Bed room doors should not, where it can be avoided, be placed opposite to one another, as if one is left unclosed on opening another, a sudden view is obtained of its inmates. But in sitting rooms, the doors are preferable opening opposite one another, this giving a view throughout, and more or less the character, of a suite of apartments. With regard to aspect it is needless to repeat here the observations which will be found in several previous portions of the work. The kitchen offices should be sheltered from the rays of the sun; and if this cannot be done by means of trees, a verandah can always be fixed. Hadley's (Chelsea) blinds may be used for the Sitting and Bed rooms, if it is considered desirable to have any. We should advise that all *E. S.* and *W*, windows should have outside deal Venetian shutters; the outside frames $3'' \times 1^1/_2''$ beaded; bottom rails $4^1/_2''$ wide; louvres $^3/_8''$ thick; the blinds hung with 4″ wrought iron butts and all necessary bolts and fastenings; they may also be made to slide. The subject of the internal finishings of the walls of domestic habitations is of considerable importance; although very little attention is paid to them in a sanitary point of view, in comparison with the attention lavished on their decoration. The walls of a kitchen are best built of rubbed sandstone and not plastered afterwards: for the

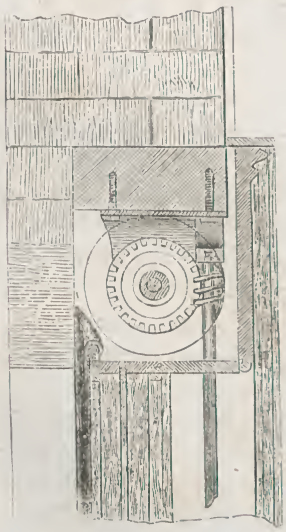
plaster looks very bad when it is covered with patches of grease and is besides being constantly knocked about and rubbed off. The most common method of finishing the walls of houses is by papering them; painting not being so generally adopted on the ground of its expense. It is an object of interesting and useful consideration whether the usual modes of finishing rooms contribute in any degree to their salubrity, and we extract from Mr. Loudon's writings a comparative view of the relative effects of papering and paint used as finishings to plastering. "It is well understood that the ceilings and walls of all the apartments of dwelling houses and other buildings in this country are now almost uniformly finished in plaster; and the nature and properties of this composition are also well known. One of these properties is its power of absorbing moisture, or, in other words, its facility in attracting and imbibing dampness. Consequently, when an apartment is left for any length of time without the benefit of a fire, or of heated air supplied by other means, the plaster will continue to absorb a portion of the dampness from the atmosphere with which the room is filled; and it is natural to suppose that where a fire is put, or heated air is otherwise admitted, this dampness will be gradually given out by exhalation from the plaster. This process of exhalation must effect the durability, not only of the plaster itself, but of the woodwork under it, and must also render the apartment much less comfortable than if it had been rendered incapable of such absorption. It therefore becomes an inquiry of some interest whether painting or papering (the two methods by which the walls of our apartments are usually decorated) is the better adapted to counteract these disadvantages." Mr. Loudon gives the preference to painting, for reasons which we do not doubt our readers will agree with us are little short of demonstrative. "It is clear," as he remarks, by painting, "the plaster is rendered incapable of absorption; and the surface of it is hardened by the oil which it has sucked in from the first and second coats, and is thereby rendered less liable to breakage, with the great advantage of being washable." To papering walls he objects seriously, and we cannot do better than give his own very sensible words. "Every one knows that paper is more or less absorbent according to its quality. When it is manufactured into paperhangings, it is washed over with a coating of size colour, equally absorbent with the paper itself, upon which a pattern is stamped of the same material. To prepare the plaster for papering it receives a coating of a weak solution of glue in water, and the paper, as every one knows, is fixed to the wall by paste. Paperhangings therefore cannot be considered, in a general point of view, as being so well adapted to plastered walls as paint; and there are particular situations in which serious disadvantages attend paper, which a short explanation will make apparent to any one. Take a dining room for example. The papered wall has nothing in it to resist the absorption of the steam of the dinner, or breaths of the large parties with which it is often crowded; the glue and paste used in paperhangings must be thereby softened, and the moisture absorbed must, therefore, be afterwards gradually given out in connection with the natural effluvia of these, the former of which we all know to be extracted from animal substances not of the most cleanly nature, until the wall be again thoroughly dry. Besides a papered wall is liable to be injured past remedy by so common a casuality as the starting of a bottle of table beer, champagne, or soda water. Lobbies and staircases are sometimes papered, although the practice is not very common in Scotland. This is very objectionable, as the condensation of the atmosphere which always takes place on the walls of such apartments on a change of temperature from cold to warmth must be absorbed, and again given out as before explained. In regard to the Drawing room and Bed rooms these particular objections to paperhangings do not apply; yet there are modes of painting Drawing rooms superior not only in point of utility but also in effect."

We turn from the consideration of the walls of domestic habitations to the floors. The hall will look well if laid with tiles in ornamental patterns, or it may be paved; wood flooring prevails in small houses. The French generally adopt *parquetted* or inlaid floors, laid with small thin boards, which are less liable to warp and twist than large boards. The diagram illustrates

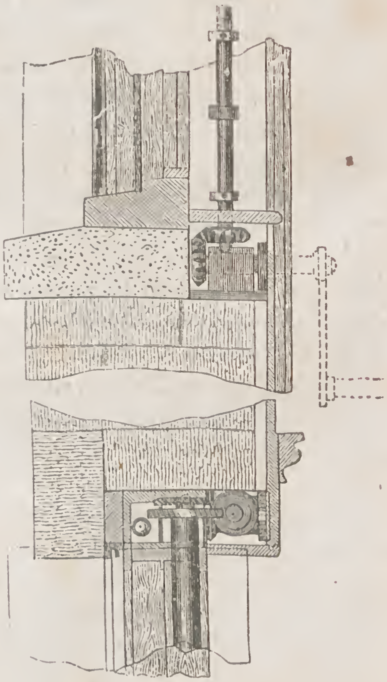


this species of flooring, That which is called in France *marquetterie* was first used in Florence and consists in different colours being used in a species of mosaic work. Speaking of the ordinary English flooring boards, Mr. Robinson remarks. — "When floors are newly laid and in good order cover them with a copious soaking of boiled and hot linseed oil and afterwards paint them with two coats of good oil colour. Very little warping will probably take place after this; and a slight sponging with cold water will at all times be sufficient to render them perfectly clean and clean looking."

With respect to window openings they should be as few in number as possible; for a number of little openings will often be found to admit less light and weaken a building more than a single moderate sized one. The windows should be spaced uniformly in a room with as equal intervals between them and the side walls as possible, not one window close to the wall and another in the centre of the room. In carrying them up they should be placed above one another, solid over solid, otherwise the balance and construction of the wall will be found very defective. Sir William Chambers says that $^1/_8$ part of the height and depth of the rooms added together will give the width of the window. In Italian architecture the height of the windows on the principal floor may be $2^1/_8$ to $2^1/_3$ their width; on the ground floor twice, on the second floor $1^1/_2$ to $1^4/_5$ their width. The distance between windows may be $1^1/_2$ to $2^1/_2$ times the width of their apertures, and at the outer angle the solid space should be rather more than that between the windows. These proportions will be found to apply both with reference to sound construction and harmonious proportion. Shutters will probably be considered an absolute requisite on the ground floor, and they certainly contribute much towards the warmth of rooms in the evenings, and, when partially closed, to their coolness in summer. Respecting their adding to the security of a dwelling we have very great doubts and certainly, if about to erect a house for ourselves, we should not dream of such expensive and cumbersome additions, always in the way and considerably detracting from the internal appearance of an apartment. As, however, they are as carefully closed at night in this peaceful city as if a bombardment were expected, we presume that the popular belief in their infallibility will not be easily shaken. They are usually hung as lifting shutters or folding, in neither case very securely. Sometimes they are hung outside the window and can of course be carried away by any ingenious gentleman. To those who really wish to render their houses secure, as well from a storming party as less noisy invaders,



Section as applied to the Windows of Private Houses.

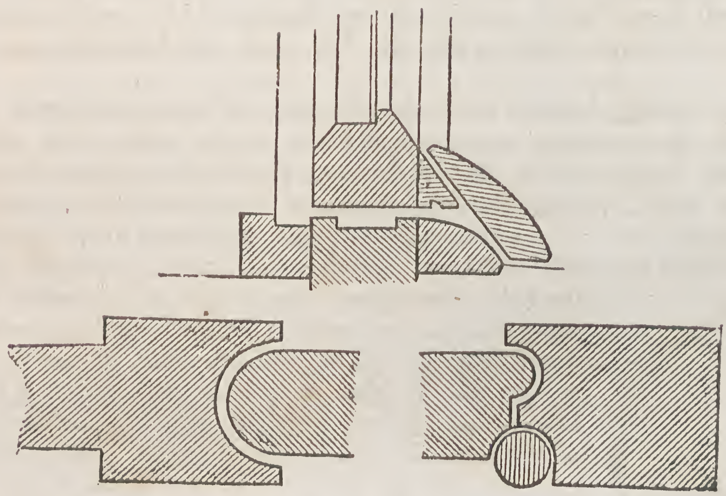


Plan of Shutter as above.

we recommend Bunnet's revolving iron safety shutters, which are nearly air tight and impervious to fire and burglars. They may be raised and lowered with perfect ease and without exertion, and the price is we believe about 6 shillings per foot super. The form adapted to private houses is illustrated in the margin, which shows also the space likely to be occupied, and that the interior of the window is not cut up and its harmony destroyed by the ugly projections, recessed spaces, cords, and apparatus which characterize internal shutters. The shutter too is, as it ought to be, outside, instead of within the glass, and thus protects that from injury. Their external appearance is most compact and satisfactory. Bunnet & Co. also manufacture and fix wood revolving shutters on a similar plan to those of iron. Their cost is of course less; about 4 shillings per foot super.

Windows are generally preferred in England with lifting sashes; but on the continent casements, called here French Casement Sashes, are used. We annex sections of parts of one sketched at an hotel at Antwerp.

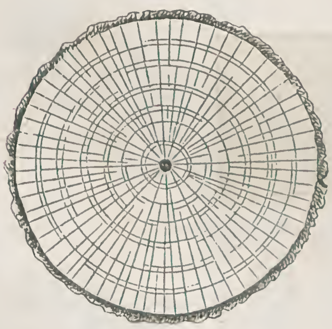
We shall continue from time to time in the descriptions of domestic houses the above general observations on their fittings and accessories.



THE TIMBER TREES USED IN BUILDING OPERATIONS.

Trees are the grandest objects in the organic world, and their importance to man can scarcely be overrated. Not only have they enabled him to transport himself to distant climes over the mighty deep, but, on the land, few substances come more generally into use than the woody fibre, or timber of trees; and the carpenter who has made the nature of this material his study has a vast superiority over one who has neglected this essential knowledge. The practical builder requires timber to be sound and durable; and these qualities depend on the absence of those natural juices which undergo fermentation, and on the wood being properly seasoned. The term timber, is limited to those woods which are, or may be, adapted to building purposes. Oak and fir are chiefly used in this country; the first being most durable, whether exposed to air, water, or buried in the earth, and it is, perhaps, the strongest of all timbers: the lightness, stiffness, and durability of fir render it also admirable for construction. Besides these, however, a great number of other woods are used. Trees may be generally classed under these heads,—1st, those which produce straight timber, long plates, masts, etc.; as the pine; 2nd, those which yield crooked or bent timber, for knees in ships, etc.; as the oak, chesnut, and elm; 3rd, trees with tough wood; as yew, holly, ash, maple, etc.; 4th, trees with hard wood, as oak, beech, plane, box, holly, yew and walnut; 5th, soft wooded trees; as horse-chesnut, poplar, etc.; 6th, woods cultivated for spray and flexible suckers for hoops, baskets, poles, etc.; 7th, woods with beautiful grains, for decorative purposes.

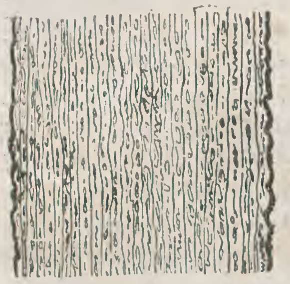
There is a certain analogy between the organic functions of trees and those of animals. When cut horizontally, the former appear composed of fibres, but, in reality, their substance consists of vessels and tubes through which the sap flows, as the blood of animals through their veins. In a square inch of wood, upwards of seven millions of these vessels have been counted. The vessels extend from the root to the leaves: and the former terminates in spongy threads, adapted to absorb moisture from the earth, whence it ascends to the trunk, in technical language named the *bole.* The figure in the margin is the section of a tree seven years old. In the centre is the pith, consisting wholly of *cellular tissue;* loose in texture, as in the alder, or compact, as at the knot of the ash. A great proportion of it, as in the alder, renders the wood comparatively valueless; it is sometimes called the heart of the tree. Its place is first occupied with a watery fluid, and next with air, and this becomes dry before the first layer of wood is perfected. The form of the cells is ordinarily hexagonal, but these undergo certain changes as the age of the tree advances. The wood is found next, which, in plants of more than two years growth, consists of separate layers, or rings, one being formed every year during the life of the tree; the thickness of these layers depending on the aspect of the tree, the situation of the root, and the degree of vegetation which has taken place. The heart, or pith of a tree, is never exactly in the centre of the trunk, but always nearest the north side. The wood is found to be stronger in the middle of the trunk than at the springing of the branches, or at the root; and the wood of the branches is weaker than that of the trunk; and that towards the south stronger than the northern parts. The layers above mentioned are not separable from one another; they consist of cellular tissue on the side next the centre of the tree, and externally of woody fibre; and the outermost layer is



spongy, and less durable than the inner. *Medullary rays* (from *medulla,* marrow, so called because they were erroneously supposed to be a continuation of the pith) traverse the wood; and the woody layers are formed from a secretion called *cambium,* deposited by the succulent vessels of the bark and the rays between the wood and the bark; which secretion, rising in one form from the root is prepared by the leaves: the result of this gelatinous fluid is transformed, by a process of nature, into the cells, or layers; the diverging as well as concentric being produced simultaneously; and these vessels form altogether what is termed the *grain* of wood. The outside layers are termed the *alburnum,* or sap-wood; the harder inner matter the *duramen* or heartwood. The new layer, formed every year, is also termed the *liber;* on this substance the ancients wrote, and its well-known name was given to a book. There are also divisions like rays, spreading from the pith to the bark, like the spokes of a wheel, and termed *lesser transverse septa,* and others of a light silver colour, called *silver grain,* or *larger transverse septa.* They are produced by the medullary rays, and consist of compressed cellular tissue, binding together the layers of the stem, and keeping open the communication between the bark and pith, which the formation of the wood would have otherwise destroyed; they give the glossy, silky appearance to plane, satin-wood, etc. By a process not yet understood, the crude, or common sap, consisting of water nearly pure, with mucilage and sugar apparently acquired in the plant, rises from the root of the tree to the leaves, where it undergoes peculiar chemical changes, and portions of the watery part being evaporated, it is prepared into a juice of a more nutritious character, and is returned along the lower set of vessels of the leaf back into the stem, passing through the *liber* and to the centre of the tree by means of the medullary rays, down towards the root, to supply nutriment to the various organs. This returning fluid is termed the *proper sap.* The cambium is chiefly formed of it; and the various oils, gums, and resins of trees and plants, are produced through the absorption of oxygen by the leaves and its union with the sap and carbon; thus forming also the carbonic acid gas breathed out by plants during the night and rendering it so unwholesome to sleep in rooms where they are placed: the reason is now also obvious why plants kept in the dark have not the power of forming woody fibre; for the sun must shine upon them to enable the carbon to produce it. The new layers or rings already described, are formed by the expansion of the bark, caused by the descent of the sap; these, as the tree increases in size and becomes old, engross all the vitality, and the inner layers harden and ultimately decay. When trees are growing, the heart wood is the strongest; when their growth is completed, other parts acquire the same strength, and when decay commences, the change begins at the heart wood. The layers are larger and more distinct in those trees which grow rapidly to a great size, as the fir, ash, etc. and much less so as well as smaller in those which grow slowly, as holly, box, etc.; they are also largest towards the outer part and the sunny side of trees. Evelyn mentions, in the "Sylva," that, "in the body of a great oak in the New Forest cut transversely even, three or four hundred layers were distinguished." It should here be mentioned, that although timber trees, the *Dicotyledonæ* class, called also *Exogenes,* are distinguished by the peculiar layers described, yet another class, the *Monocotyledonæ,* or *Endogenes,* are differently organized. The former are increased in bulk by additions on the outside of the wood and bark; while in the latter there are no distinctions of wood, pith, bark, and rays. As shown in the margin, the substance consists of fibres and ducts, irregularly dispersed in a mass of cellular tissue, as if a bed of one kind were studded with specks of another tissue, and crowded more closely together towards the outer portion; which is increased by the successive descent of new bundles of fibre to the centre; the leaves also greatly differ in the two varieties. Palms and bamboos are of this class, and, in England, the annuals and herbaceous

plants. From the middle of June to the middle of August there is an apparent pause in the vegetation of trees. As the leaves are developed, the sap ceases flowing; while in transit the bark may be easily separated in the spring and autumn: the sap wood is, however, more liable to decay than the heart, as it contains those juices which readily ferment, and mischief follows from confining them with pitch and paint, or bedding the ends of unseasoned timber in new walls; and sap-wood is more subject than the heart-wood to the depredations of worms. The bark, or outer cuticle, is a membrane extending like a net over the surface of the wood. It consists of layers and ducts divided into four parts; the epidermis, the cutis, the cellular, and the liber, or inner bark. The longitudinal fibres are formed of hollow tubes, which answer the purpose of conveying the sap. The bark or rind is reproduced annually, and the old layers are pushed outwards: as the tree grows, the bark stretches, sometimes considerably; but, when it does not admit of being easily stretched, as that, for instance of elm, it cracks and ultimately drops off, the outward layer of the liber supplying its place. The birch and many other trees "cast their bright skin yearly, like the snake." The rind is colourless and transparent when it is very thin; but ordinarily of a grey or brown colour when thick; in old trees the bark is proportionately thin compared with the thickness of the trunk. It is undoubtedly a separate membrane, composed of minute cells or "bladders," as Grew terms them, which shrink and dry up as the tree becomes old.

Exogenes.

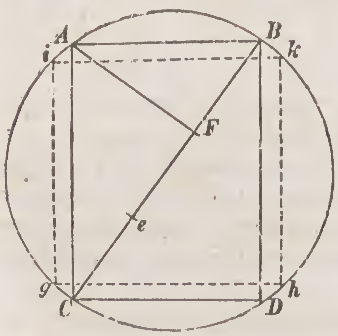


Endogenes.

Having made these few observations on the anatomy and chemistry of trees, physiological facts which all practical men should understand, we will now proceed to consider very briefly the best periods for felling timber.

"Cut no trees," says Evelyn, "when either heat or cold is in extremes; nor in very wet or snowy weather;" and the same author also remarks,—"to make excellent boards and planks, 'tis the advice of some, you should bark your trees in a fit season, and so let them stand naked a full year, before the felling." From what we have previously observed, it must be evident that trees felled too soon consist chiefly of sap-wood, not sufficiently hard, but in the mature trees, the hard wood predominates. There are three stages of the growth of timber; first, when it grows rapidly and the wood is soft; second, when it has become firm and strong; and third, when it is weak and decayed. Loudon recommends the beginning of the middlemost of these stages as the proper period for felling. Vitruvius chose the autumnal fall; Cato thought the fruit should be ripe; and Vitruvius agrees with this. Oak trees, says Daviler, are not to be felled under 60, or above 200 years of age; Bellidor preferred 100 years. Between November and February is a good time for elm; and Tredgold recommended that ash, larch and elm, should be cut between 50 and 100; and poplar between 30 and 50 years of age. Norway spruce and Scotch pine are generally cut between 70 and 100 years. Those who work much in wood, especially in small works, find a remarkable difference in it according to the time when it is felled. Some woods if cut in summer, work toughest, others the reverse, and many hard or mellow under the same circumstances. The proper time, generally, for felling trees is when the greatest amount of hard and durable wood can be obtained from them, free from sap. They should be mature; then the heart-wood is of tolerably equal character; before there is a great disparity between the central and outer layers. As soon as felled, timber should be removed to a dry, airy and well-drained situation, and be so stacked that the air may circulate freely round èach piece; but it ought not to be exposed to strong currents, or to the heat of the sun: the timber yard is preferable if strewed with ashes or scales from a foundry. The trees are

best quartered at once; and squared timber is not so liable to rift as that which is round. "Round blocks cut out of the entire circular stem of green wood, or the same pieces divided into quarterings, split in the direction of the medullary rays, or radially; also, though less frequently, upon the annual rings. Such of the round blocks as consist of the entire section contract pretty equally, and nearly retain their circular form; but those from the quarterings become oval, from their unequal shrinking. In general, woods do not alter in any material degree in respect of length: boards and flat pieces contract however in width; they warp and twist, and when they are fitted as panels into loose groves, they shrink away from that edge which happens to be the most slightly held; but when restrained by nails, mortises, or other unyielding attachment, which do not allow them the power of contraction, they split with irresistible force, and the materials and labour thus improperly employed will render no useful service." If beams are employed the full size of the tree, boring a hole through them is a good practice. It is irregular and partial drying which contributes so greatly to damage all kinds of woods. The most even trunks are preferable; a swelling in them and excrescences are signs of decay; knots weaken wood and fractures are most likely to occur near them. Metals, as is well understood, are rendered longer and thicker by heat; the contrary is the case with wood, for it is shortest in hot and longest in cold weather. This is owing to the condensation of the sap, by cold: as all liquids are increased in volume by freezing, and wood thus changes its bulk when more or less filled with sap: we may thus ascertain the proportionate amount of sap in timbers. The following problem teaching the mode of cutting the strongest possible beam out of the trunk of a tree will be found useful: *A. B. C. D.* being the section, draw the diameter *C. B.* and divide it into three equal parts, *e. F.* and from *F*, draw *F, A.* perpendicular to the diameter; draw *A. B.* and *A. C.*, *C. D.* and *B. D.*; then *A. B. C. D.* is the piece required. It is thus evident that the strongest piece does not contain the greatest amount of timber; for the largest rectangle which can be inscribed in a circle is a square *i. k. g. h*, as indicated by the dotted lines, which is by no means stronger relatively with *A. B. C. D.*



It is a common practice to lay timber in yards on rotten and decayed pieces of wood; nothing is more to be reprehended, as the bad will infect the sound and hasten its decomposition. The more gradual the drying operation the better; and two years after felling is the least period that should be allowed to elapse previous to using any wood. Depriving trees of their bark before they are cut, so as to allow the juices to escape is thus recommended by Vitruvius,—"when a tree has an incision made through the sap-wood at its trunk it soon dies, and no further change takes place; and the barking of trees, when in full growth and vigour, and letting them stand a twelvemonth after the operation, is admitted not only to improve the quality, but to increase the quantity, at the same time that it seasons the wood; time however, is the best seasoner, and no artificial method can equal the natural process, which is that of getting rid of all the juices in so regular a manner, that dissipating them does not too rapidly shrink and crack the timber. Trees may be suffered to stand too long before they are cut down, but this is not a usual fault; for often when they can measure to a load, which in half a century is sometimes the sase, they are marked for felling, the heartwood not having either acquired its hardness or its full quantity."

We cannot better conclude our observations on the felling of timber than by placing before the reader some valuable practical remarks by John Evelyn in his now standard work, "Sylva, or a Discourse of Forest Trees." Although published 1664, it is far more worthy of consultation than many works of our own day, and it considerably stimulated landowners to form plantations.

We have before quoted Vitruvius, the only classic architect whose literary works have reached modern times, and whose books prove that to many practical matters the ancients gave as much careful consideration as they did to the still unsurpassed beauty of their architectural designs. Besides, although tastes may change, the laws of nature are ever the same, and with respect to her, "industrious observations, grounded conclusions, and profitable inventions and discoveries" ever retain their true utility, undisturbed by the fluctuations of fashions and the waverings of a capricious popularity.

"Lay up your timbers very dry, in an airy place, yet out of the winds or sun, and not standing very upright, but lying along, one piece upon another, interposing some short blocks between them to preserve them from a certain mouldiness which they usually contract while they sweat, and which frequently produces a kind of fungus, especially if there be any sappy parts remaining."

"Some there are yet who keep their timber as moist as they can by submerging it in water, which they let it imbibe, to hinder the cleaving, and this is good in fir, both for the better stripping and seasoning; yea, not only in fir, but other timber. Lay therefore your boards a fortnight in the water (if running, the better, as at some mill-pond head); and then, setting them upright in the sun and wind, so as it may freely pass through them (especially during the heats of summer, which is the time of finishing buildings); turn them daily, and thus treated even newly sawn boards will floor much better than many years dry seasoning, as they call it. But to prevent all possible accidents, when you lay your floors, let the joints be shot, fitted, and tacked down only for the first year, nailing them for good and all the next; and by this means, they will lay staunch, close and without shrinking in the least, as if they were all one piece. And upon this occasion I am to add an observation, which may prove of no small use to builders, that if one take up deal boards that may have laid in the floor a hundred years, and shoot them again, they will certainly shrink without the former method. Amongst wheelwrights, the water seasoning is of especial regard, and in such esteem amongst some, that I am assured the Venetians, for their provision in the arsenal, lay their oak some years in the water before they employ it. Indeed, the Turks not only fell at all times of the year, without any regard to the season, but employ their timber green and unseasoned; so that though they have excellent oak, it decays in a short time only by this neglect.

"Elm felled ever so green, for sudden use, if plunged four or five days in water (especially salt water) obtains an admirable seasoning, and may immediately be used; I, the oftener, insist on this water seasoning not only as a remedy against the worm, but for its efficacy against warping and distortions of timber, whether used within or exposed to the air. Some, again, commend burying in the earth; others in wheat; and there be seasonings of the fire, as for the scorching and hardening of piles, which are to stand either in the water or in the earth.

"When wood is charred, it becomes incorruptible; for which reason, when we wish to preserve piles from decay, they should be charred on their outside. Oak posts, used in enclosures, always decay about two inches above and below the surface. Charring that part would probably add several years to the duration of the wood, for that to most timber it contributes its duration. Thus do all the elements contribute to the art of the seasoning.

"Timber which is cleft is nothing so obnoxious to reft and cleave as what is hewn; nor that which is squared as what is round: and therefore where use is to be made of huge and massy columns, let them be bored through from end to end. It is an excellent preservative from splitting, and not unphilosophical; though to cure the accident painter's putty is recommended; also the rubbing them over with a wax cloth is good.

"We spoke before of squaring; and I would now recommend the quartering of such trees as will allow useful and competent scantlings to be of much more durableness and effect for strength, than where (as custom is and for want of observation) whole beams and timbers

are applied in ships or houses, with slab and all about them, upon false suppositions of strength beyond these quarters.

"For all uses, that timber is esteemed the best, which is the most ponderous, and which, lying long, makes the deepest impression in the earth, or in the water being floated; also what is without knots, yet firm and free from sap which is that fatty, whiter, and softer part called by the ancients *albumen,* which you are diligently to *hew* away. My Lord Bacon (Experiment 658) recommends for trial of a sound or knotty piece of timber, to cause one to speak at one of the extremes to his companion listening at the other; for if it be knotty the sound, says he, will come abrupt."

Some trees attain a great size and age. A cypress at Alexo in Mexico, is 76 feet in girth; another at Santa Maria del Tuti is 118 feet. A yew in Brabourn church-yard, Kent, is considered to be 3,000 years old; that at Hedsor, in Buckinghamshire, 3,240 years; it measures 27 feet in diameter. Pliny found Numidian cedar 1,200 years old, in good preservation, in the temple of Apollo at Utica. A pile of the bridge of Trajan over the Danube was found, when taken up, perforated $^3/_4$ of an inch, but the remainder was in good condition, although upwards of sixteen centuries have passed away. The timber forming the dome of St. Mark in Venice is more than 800 years old and is in excellent preservation; and that of the roof of the basilica of St. Paul in Rome, framed A. D. 816, is still in a sound state.

We shall now place before the reader a few observations on the nature of the several kinds of timber, being indebted for them to several practical works.

OAK *(Quercus Robur).* This tree is the most valuable of all those grown in England for the many important, useful purposes to which its durable timber and astringent bark are applied. The Quercus Robur, or common English Oak, the finest specimens of which are said to be grown in Sussex, is considered the best; the leaves have irregular sinuosities and short footstalks, and the acorns long ones. It is found in most temperate parts of Europe. It attains a great size, is straight grained and fairly clear of knots. The grain is fine and of a red tinge. Wherever stiffness is an object, this wood is excellent, for girders, joists, roofs, stairs, etc., and it cleaves easily into pales, and laths for plasterers and slaters. In many respects it is similar to the German wainscot. The *Quercus Sessiliflora* or Sessile fruited oak, is said to be the old Druidical English or naval oak, although the Robur is more frequently met with in old forests. The acorns of the Sessile are set close to the branches, and the leaves have long footstalks with more regular sinuosities, and it is altogether not so elegant a tree as the Robur. In consequence of the elastic quality of the timber of the Sessile, it is considered admirable for ship building: it is rather liable to warp and split, but its toughness and hardness are very great. It is not adapted, like the Robur, for laths, but what distinctions there are, are perhaps more owing to differences of soil than to any specific distinctions between the varieties; and Sir H. Davy observed they are much more likely to decay if grown on a moist than on a dry soil. The wood of the Sessile is darker in colour than the Robur; the grain is not so fine, and is often mistaken for Chesnut, but they may be respectively known from the circumstance of the chesnut not having the large transverse septa observable in oak, and the pores of the alburnum are much smaller and more thinly set in the former. Besides these two species which are indigenous in England, there are thirteen exotics. The *Esculus,* or holme oak, described by Vitruvius as having its "elements *composed of earth, air, fire, and water, in more equal proportions than others,* is of great use in building, but damp soon destroys it; and *its air and fire being driven off,* it soon rots." The *Quercus alba,* or American oak, is of quick growth, but not so durable as the English; and the Rubra, or red oak of Canada, is spongy and by no means to be depended on. *Quercus suber,* or cork-barked oak is much used for various purposes in Spain. *Clapboard* is a species of oak imported from Norway; that brought from Holland is called *Dutch wainscot,* although grown in Germany, and floated in immense rafts down the Rhine. It may be easily distinguished from clapboard by having no white streaks, and it is a much superior

wood to the latter. They are both used in England for fixtures and *wainscoting*; and the Dutch wainscot is not so liable as English oak to warp and split, and is thus often preferred by the joiner. The Italian oak grows faster than the English, but is of shorter duration. Lately, the fine curled oak got from excrescence on pollard and other trees has been used for furniture. Oak seldom attains its maturity under 100 years, but it is better to fell it a little before than after this period, as it is then stronger. It is chiefly used in England for shipbuilding, although it formerly occupied more the place which fir does. Of all woods oak is perhaps the most durable; and, when constantly dry, it will last a thousand years. The colour is a fine brown; that inclining to red being of inferior character. It warps, twists, and shrinks considerably in seasoning; but no wood bears better the wear of situations alternately dry and wet, and it may be applied to a vast variety of requirements. The strength of oak is owing to its density which is in proportion to the length of time occupied in its growth; the heaviest wood is always the strongest, and that which grows on light soils is not so dense and compact as what is produced from cold soils. The weight of a cubic foot is about 54 lbs. but varies according to the character of the soil which produces it.

CHESNUT *(Fagus Castanea)*. A species of oak used in the mediæval ages has been frequently mistaken for chesnut; but we have before explained the distinction between the two. Chesnut is a magnificent forest tree, excelling all others in its huge mass of foliage. The mean length of the trunk is 44 feet: and from its containing but a small proportion of sap wood, it often rivals oak in durability, but it is not, after all, to be trusted so much. It is easier to work than oak, and is equal to it for waterpipes, tubs, and vessels for water. It is also used by the Italians for wine casks. It does not shrink, swell, or fly after seasoning; when young, it is more flexible and hard, the old wood being shaky and brittle. A loamy gravel seems to suit this tree best, and Sir H. Davy says it is most liable to decay on a moist soil. The horse-chesnut is soft and ill adapted to building purposes, but it has been used for water pipes. The weight of chesnut is about 41 lbs. to the cubic foot. "The use of chesnut," said Evelyn, "is next the oak, one of the most sought after by the carpenter and joiner; it hath formerly built a good part of our ancient houses in the City of London as does yet appear. I had once a very large barn near the city, framed entirely with this timber, and certainly they grew not far off, probably in some woods near the Town: for in that description of London written by Fitz-Stephens, in the Reign of Henry II., he speaks of a very noble and large forest which grew in the *boreal* part of it."

FIR TIMBER.

YELLOW FIR *(Pinus sylvestris)*.

This is of all the species the most valuable. It is a tall and straight tree, having few branches on the lower part of the stem, the leaves being chiefly confined to the upper part, there forming a massive clump. Although indigenous to the Highlands of Scotland, little that is in general use for building operations comes from thence; the forests of Norway, Denmark, Russia, Prussia, Poland, Lapland, and Sweden supplying the finest timber. Its qualities vary according to the character of the soil on which it is grown; a stiff cold earth gives it a red colour, and it acquires on it a solidity and strength which that produced on sandy or light lands does not possess; the colour of this latter being almost white, thus accounting for the different names derived from these characteristics. The Laplanders and Kamschatdales convert the soft, white, succulent bark into bread. Under the name of *red wood*, the *pinus sylvestris* is imported into this country in logs and deals. Much of it is floated on the Gotha to Gottenberg, divested of its bark, and on the Glomm to Christiana; but the Riga is considered the best from the Baltic; and the Russian timber is so long in reaching the port of Cronstadt that its quality is much deteriorated. Norway exports no trees under 18 inches in diameter. Masts come from Riga, 18 to 25 inches in diameter and 70 or 80 feet long, and also square, which are less than 18 inches in diameter. From the small size of those from Norway, there is much sap in them, but the heart wood is stronger

and more durable than that from other trees. Fir is also imported from several parts in the form of deals and planks. In Scotland this species attains, on good soils, a great size; one at Dunmore contained 300 cubic feet. The appearance of fir timber varies very considerably: it is generally of a red colour of different gradations of brightness; its concentric rings are rarely so much as $^1/_{10}$ of an inch in thickness. The section exhibits hard and soft alternate layers, one light, the other dark coloured; and the annular rings are much thinner in those of the best kinds, and they do not cut so as to leave a rough or woolly surface: it has no larger transverse septa; when spongy it is bad, but it works easily if it has not too much resin. If the saw is choked with a soft clammy resinous matter, this is a proof of the inferiority of the wood; and much from Sweden presents this defect, although the timber from thence is generally the toughest. The durability of fir is very great. Mr. Brindley "thought the red Riga deal, or pine wood, would endure as long as oak in all situations." There is an instance cited of its having been observed in the roof of a castle, three hundred years after it was placed there, as full of sap and as resinous as if just imported. Its stiffness and superior lightness render it admirable for girders, joists, rafters, framing, etc., and for all kinds of joinery. When protected it is almost as durable as oak, and it has the advantage of cheapness; for masts it is in constant requisition, as well as for other parts of vessels. None of it, however, is capable of bearing much strain, excepting in the direction of the length of its fibres. A cubic foot weighs, when dry, from 30 to 40 lbs. That from Memel is found to be the most suitable for size, 13 inches square being considered convenient; Riga is the most esteemed for quality, and it may be used almost anywhere; it is also preferred for masts for the navy. Swedish timber is the toughest, and Dantzic the strongest. Evelyn says of fir timbers, — "They make our best masts, sheathing, etc., therefore the whole vessel. It is pretty, says Pliny, to consider that those trees which are so much sought after for shipping should most delight in the highest of mountains, as if they fled from the sea on purpose, and were afraid to descend into the waters. With fir we likewise make wainscot, floors, laths, boxes, and wherever we use the deal; nor does there any wood so well agree with the glue as it, or so easy to be wrought. It is also excellent for beams, and other timber work in houses, being both light and exceedingly strong, where it may lie dry everlasting, and an extraordinary saver of oak, when it may be had at reasonable price." In selecting it, sponginess and porousness in the grain should be avoided, as also all dead knots; the brightest in colour are the best specimens.

WHITE FIR (*Pinus Abies*). This is a genus of the Coniferæ, that from Norway being best known; it attains a great height with little bulk and furnishes the white deal or spars, commonly called the *spruce* of Norway. Considerable quantities are imported from Christiana in *deals* 3 inches thick and 9 inches broad; when these are cut into two, they are called *whole deals;* when into four *split deals;* and when cut into five, *five cut stuff.* They are sold in this country by the 100 of 120. The colour is a yellow or brownish white; the knots are rather tough, and, in seasoning, deals shrink about a 70th or 90th part. A cubic foot of white fir weighs 34 lbs. It is more used than yellow fir for internal and ornamental work, cornices, panels, chimney pieces, etc.; it also unites with glue better than the yellow, and is durable in a dry state; but all fir should be well seasoned, for no wood is more apt to shrink and fly. Mr. Laxton says that, "for framing, the best deals to be depended upon are the Norway, particularly the Christiana battens, and for panelling the Christiana whites; yellow Christiana deals cause much waste, being generally sappy; the best floors are Dram and Christiana whites; Stockholm and Gefle yellows for ground floors; Archangel and Onega planks for warehouse floors and staircases; Petersburg, Onega and Christiana battens for best floors. Swedish deals are not to be depended upon for framing; if tied up square at night they will be crooked in the morning." We should mention that battens are 7 inches wide; deals 9 inches, and planks 11 inches.

AMERICAN PINE (*Pinus strobus*). This, which is called the Weymouth or white pine is a

majestic tree, which has been known to tower to the height of 250 feet; it is imported from Canada and other parts of North America in logs about 30 feet long and 2 feet square. It is much used for masts, has a clean straight grain, is light and soft, and very useful consequently in joinery; it also stands the weather tolerably. The colour is a brownish yellow, and the texture uniform; but it is not very durable and is very subject to the dry rot. The weight of a cubic foot is 29 lbs.

THE YELLOW PINE (*Pinus mitis*) is called in this country the New York, and having a great proportion of turpentine, it is often found very durable as well as strong.

There are many other varieties of trees more or less used. The Quebec yellow pine may be used in dry work, but the lower port timber is not to be depended upon. *The Silver Fir;* called also the *Pitch Fir;* and the Chester Pine (*pinaster*) may also be mentioned as cultivated in the British plantations; they are both of fair quality.

ELM (*Ulmus*). This is a lofty and valuable tree of a very ornamental appearance. It is very probably an exotic, for the seeds never ripen in this country. The *Ulmus campestris* is that chiefly used for coffins, and it is the hardest and most durable of the English species. The *Ulmus suberosa* is very common in Sussex, and is not so valuable. The *Montana*, or broad-leaved, is that most commonly produced in Europe. The *glabra*, or wych elm, is common in Essex, and is used by wheelwrights: the *Major*, or Dutch elm, is very inferior in quality. The colour of the heart-wood is of a reddish brown, and it is darker than that of oak, and the sap-wood is of a brownish-white colour. The weight of a cubic foot is about 48 lbs. Elm has no large septa; it has a peculiar smell, is porous, cross grained, warps greatly in drying, and diminishes considerably in both length and breadth, and it is very difficult to work. It is very durable in situations where it is constantly wet, and it was used for the piles of old London Bridge; we have ourselves a specimen as firm as ever; it is also durable in a dry state. It will not however bear alternate wet and dryness, and it is, consequently, of little value for the general purposes of the builder. For piles, pumps, keels of ships, etc. it is admirable; and, as it is very cross-grained and not liable to split, it bears well the drift of bolts and nails, and it is much in use for dressers, chopping boards, etc.

BEECH (*Fagus Sylvatica*). This fine, lofty, stately tree is commonly found on the chalky and limestone districts. Pliny describes it as one of the thirteen species of trees bearing masts or acorns. The wood is smooth, hard, and close, its transverse fibres very obvious and the grain dry and even. It is very subject to the worm, and the seasoning should therefore be very carefully attended to. Beech is easy to work, the white being the hardest, the black, according to Evelyn more durable; it is also tougher. In a dry state it is very liable to crack and split; under water it is very lasting, and is much used for piles and planking; but from the injurious effects of the least dampness at the ends, it is very little used in building. It is in great vogue for tools, its hardness and uniform texture being peculiarly desirable; it is also in demand for furniture.

WALNUT (*Juglans regia*). Although chiefly regarded as a fruit tree, the lightness and durability of its timber and the facility with which it may be worked render it very useful. Evelyn remarks, — "What universal use the French make of the timber of this tree for domestic affairs may be seen in every room, both of poor and sick: it is of singular account with the joiner for the best grained and coloured wainscot, etc." It was also praised by the Greek authors for furniture. Excepting cedar, walnut is less liable than any other wood to be infected by worms: the texture is very cross grained, and it has a beautiful vein; it will neither warp nor crack, and its rich brown colour is preferred to mahogany by many persons for furniture. It was greatly used by the ancients for building, and would probably be so now, were it not for its scarcity. It is however too flexible for beams; rooms wainscoted with it have a good effect, and although it does not work so easily as mahogany, it may be brought to a smoother surface. It is in considerable requisition for cabinet-work, Gun stocks, screws of presses, etc.

MAHOGANY (*Swietania Mahogani*), so called in honour of Gerard van Swietan, a Leydan physician. This wood is largely imported from America, the West India islands, etc., in logs 10 or 12 feet long, and about 2 feet square.

Honduras is brought over in larger logs, sometimes even 6 feet square, and 18 feet long. It was first used to repair some of Sir Walter Raleigh's ships at Trinidad, and afterwards a piece was formed in England into a candle-box for Dr. Gibbons, being presumed useles for other purposes. That from the islands is called Spanish mahogany; the annular rings are not very distinct, it has no larger septa and is harder and closer grained than the Honduras, and of a lighter colour. By some, Honduras has been considered a different species, but it is probable that difference of soil has varied its quality. The latter is also coarser, soft and spongy in texture, and more open and irregular in grain; it is chiefly grown on low marshy grounds, the more beautiful, veined and mottled coming from high lands: veneers are much used of this last. The best description is that of a golden colour and freest from grey spots. Exposure soon destroys mahogany in this country; but, if properly seasoned, it is not liable to the depredations of worms. The tree grows straight and to a great height, with a diameter of about 5 feet. It makes excellent floors, roofs, joists, etc., but the expense has limited its application in this country to doors, hand rails of stairs, windows, etc. Mahogany is also used in parts of machinery, and, from its taking a high polish, it is admirable for furniture and wherever ornamental effect is studied. The wood is very hard, is held firmly with glue, and from the circumstance of its not splintering when struck by shots, it is very applicable for ships of war. Some idea may be formed of the value of the best Spanish Mahogany from the fact that the Messrs. Broadwood gave £ 3,000, for three logs, each 38 inches square, and 15 feet long. Ratteen, a common species, is much used for shop fronts. A cubic foot of mahogany weighs from about 35 to 54 lbs.

MAPLE is not subject to warp and twist and is very light. The bird's eye maple has beautiful shades to its spots, and is highly prized as an ornamental wood. It was used by the Romans for ornamental tables.

CEDAR (*Cedrus pinus*). This tree grows to an immense size, its colour is a rich yellow brown, and the annual rings consists of two layers, one three or four times the thickness and softer than the other. It is not subject to worms, and it works easily. We have before quoted the instance mentioned by Pliny of its durability; it was used by Solomon in his temple, and Vitruvius says that the timber work of the temples of antiquity was of this wood. The trunk grows sometimes 50 feet high, and the mean weight per cubic foot is about 40 lbs. The white and the red cedar are adapted for joiner's work and furniture; the latter, used for lead pencils, comes from the West India islands, North America, and Japan. Bridges constructed of the East Indian Cedar have stood the torrent for 500 years.

LARCH (*Pinus larix*). This tree is of a most beautiful figure, with an elegant stem, tapering to a point, with pendulous branches. In many parts of the country it is gradually superseding the common fir, although it is only of late years that it has been greatly cultivated in England as a timber tree. By the ancients this wood was highly prized. Vitruvius regretted the difficulty of transporting it to Rome; it was procured from Rhetia and Switzerland. Scamozzi thought larch the most useful of all woods for construction. Wiebeking preferred it to pine, pinaster, and fir for timber bridges. It is of a reddish brown colour, and more difficult to work than Memel timber, though, not being so knotty, it is first-rate for carpenter's work, and is well adapted from its strength for girders, beams, joists, etc. It is however very liable to warp and twist, but, if properly seasoned, will stand well. It is much used for water pipes in France and Switzerland, and the Swiss cover their houses with larch shingles, and finish also the interior with this wood; for which latter purpose its power of taking a high polish after planing renders it peculiarly suitable. Larch is very durable in most situations, failing generally only when other woods would do so: it is good for flooring, boards, and stairs where there is a great amount of wear.

and it is excellent for posts, pales, and situations where exposed to weather. A cubic foot weighs about 30 lbs.

POPLAR (*Populus*). This tree grows rapidly to a great height, and there are five species cultivated in England. The colour is a brownish white, and the annular rings are uniform in texture. Vitruvius recommends poplar where great strength is not required. It is used for flooring boards, does not easily split by nails, and Evelyn remarks that it "burns untowardly". For any purposes when there is not a great amount of wear poplar may be used.

ALDER (*Alnus*). This tree flourishes on a damp bog-earth soil, and is very valuable for piles and water pipes. It works very easily and is good for models, for casting. Vitruvius says the buildings of Ravenna stand on piles of this wood, and Evelyn asserts that the celebrated bridge of the Rialto, in Venice, is similarly supported. It weighs when dry 48 or 50 lbs. per cubic foot. Birch is a species of alder.

ASH (*Raxinus excelsior*). This is a very valuble hard-wooded tree, and it is common in Europe and the northern parts of Asia: it grows with a straight trunk to a great size; the young wood is more valuable than that which is old, but the character of the soil considerably modifies it. When the wood is young it is easy to work, but, after seasoning it becomes tough and hard. The texture is porous and compact, and of a brownish colour; that of young trees being white, with a greenish hue. The weight of a cubic foot is when dry about 50 lbs. If subjected to alternate dryness and moisture the timber of this tree is not durable, but it is so if protected from the weather. It is much used for many rural purposes, independently of its deficiency in durability, but it is much superior, according to Tredgold, to any other wood for its toughness and elasticity; and it is much used where sudden shocks are to be sustained, as posts of implements and machines.

SYCAMORE, OR GREAT MAPLE (*Acer pseudo-platanus*). This is a hardy, native tree which grows more rapidly than most other hard woods. The colour is a yellowish brown, when old, and white and silky, when young, and it is sometimes variegated: the annular rings are indistinct and the texture uniform, compact, and fine grained; it is durable in a dry state, but is very subject to the attacks of the worm. Sycamore is much employed for household utensils and objects in turnery, and in furnishing the wooden platters used in the olden days in England together with other household utensils. Ware remarks that it was formerly used in England for floors in houses wainscoted with poplar.

BOX (*Buxus sempervirens*). This is generally grown as an evergreen shrub but sometimes attains a height of 30 feet. Its timber is imported from Turkey: when an exceedingly fine cross-grain is required this is softer, more curly and paler than the European. Box is a valuable wood of a warm yellow colour and very heavy and durable. For the wood engraver it is in almost exclusive use; it takes a fine polish and is much employed by turners, also by mathematical instrument makers for rules and scales. Planed, its surface is as smooth as polished metal.

WILLOW (*Salix*). This is a very extensive genus, including those shrubby species, the osiers, used for basket making. It is both soft and light, if kept from wet, and is excellent for rafters and light timbers: the Romans used it for shields.

PLANE (*Platanus orientalis*). This tree grows very lofty and straight: Pliny mentions one at Lycia 81 feet in circumference. The wood resembles beech in some respects; it works easily, is used for furniture, and is also applied by the joiner and cabinet maker. The North American plane is used in the construction of quays, and is very durable immersed in water.

ACACIA (*Robinia pseudo-acacia*). This is a highly ornamental and also a valuable timber tree In Virginia it is called the *locust tree.* It is very durable for constructive purposes, and it is more heavy, harder and tougher than oak, more elastic, and its lateral strength is also superior. It is used by Mill-wrights for cogs, etc., and it is admirable for posts placed in the ground, fences, pales. etc., and for most purposes to which oak is applied.

CYPRESS is very durable and has been supposed to be the *Gopher* used in the ark. In Egypt, it was used for the mummy cases and constantly by the ancients for statues, etc. This wood is harder than pine, is of a fine grain, of a yellowish red colour.

HORNBEAM is an inferior timber tree. It is a hard tenacious wood invaluable to the plough and cart-wright and for cogs of wheels, etc.

HOLLY seldom reaches a great size and the veins are scarcely perceptible. Its timber is white and hard, and is valuable for veneering and also to the joiner, engineer, and cabinet maker.

LIME is much used for ornamental carving and cabinet work, for which its creamy, white colour, its softness, lightness, and the firmness of its grain render it admirable: it is of a pale yellow colour, easy to work and adapted for carriage panels, sounding boards, etc., the white portions of the Tunbridge-ware patterns are mostly formed of it, and the ancients used it for sculpture.

LIGNUM VITÆ is a hard wood much used by millwrights and others.

OLIVE was greatly used by the ancients to tie their walls together, and also in roofs. It is suited for the purposes of the carpenter and joiner, and, when covered, is very lasting.

TURTOSA, OR AFRICAN TEAK is useful for the same purposes as oak; and the *Indian oak* or *teak* is used on almost every occasion in India.

LABURNUM is a hard and compact wood and very durable when exposed to the weather: it is much used by turners.

IRON BARK is from New South Wales: it is a valuable wood, admitted only since the period of the Great Exhibition among the eight adopted as first-rate in the English Dock yards for ship building, and consequently proved applicable to very many purposes on land. It resembles pale brown Spanish Mahagony, and appears to be the most solid and heavy of all woods. Its strength is 1.557 (that of oak being 1.000), and the density is 1.426.

THE FOLLOWING IS A TABLE OF THE TIMBERS USED FOR VARIOUS PURPOSES.

General construction.	*Durable in Wet Works*	*Durable in Dry Works.*	
Oak	Oak	Oak	Alder
Fir	Elm	Deal	Ash
Pine	Beech	Poplar	Sycamore
Chesnut	Alder	Chesnut	Willow
Elm	White Cedar	Cedar	Plane
Beech	Plane	Teak	Acacia
Teak	Teak	Olive	Cypress
Walnut	Larch	Pines	Hornbeam
Mahogany	Plane (N. American)	Walnut	Holly
Cedar	Acacia	Mahogany	Olive
Larch	Iron Bark	Maple	Iron Bark
Poplar		Cedar	
Acacia		Larch	
Spruce fir (scaffold, ladders, etc.)			

For Patterns for iron Works.	*Hardest English Woods.*
Deal	Box
Alder	Elm
Pine	Beech
Mahogany	Oak
	Walnut.

The following useful Table is compiled from Cresy's Encyclopædia of Civil Engineering and Gwilt's translation from a synopsis in Rondelet's work. The primitive horizontal strength of Oak is considered as 1000, and its vertical strength at 807.

	Mean height of Trunk	Specific Gravity	Primitive Horizontal Strength	Primitive Vertical Strength
Acacia	12.79	789	780	1228
Alder	44.77	655	644	780
Ash	38.37	789	1072	1112
Beech	44.77	720	1032	986
Birch	47.97	702	853	861
Box	15.99	919	1160	1444
Cedar	51.16	603	627	720
Chesnut	44.77	720	957	950
Ebony	19.18	1054	1155	1062
Elm	44.77	738	1077	1075
Fir	57.56	542	918	851
Larch			843	902
Lime			750	717
Oak	44.77	905	1000	807
Pine	47.97	612	882	804
Plane	44.77	622	728	830
Poplar	47.97	415	586	680
Sycamore	31.98	645	900	968
Walnut	47.97	680	900	733
Yew	15.99	778	1037	1375

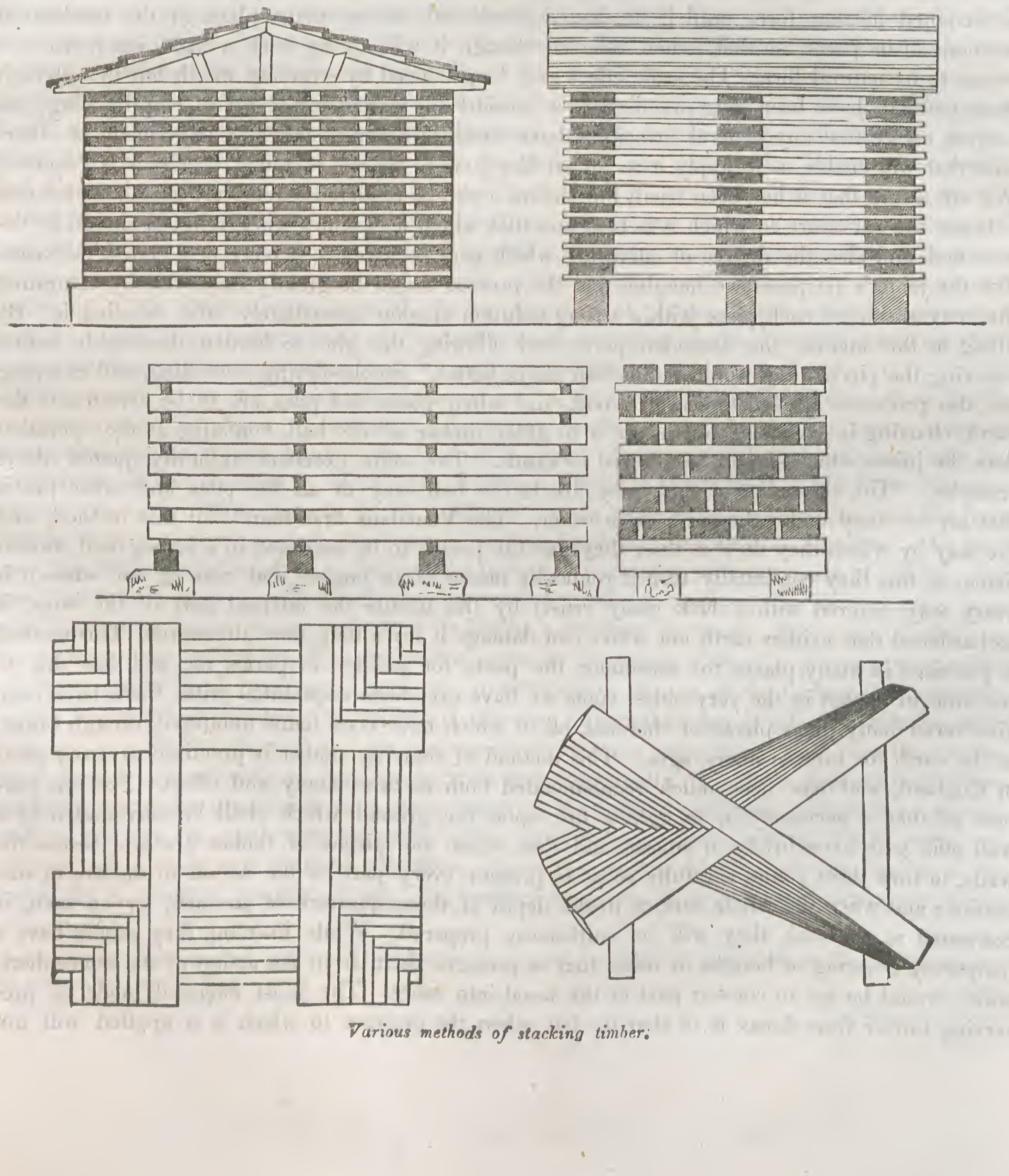
From this it is seen that the trunk of Fir attains the greatest altitude 57.66 feet, and that of Acacia the least, 12.79 feet; that Ebony has the utmost specific gravity 1,054, and Poplar the lowest; that Box wood is the most distinguished for primitive horizontal strength, and Poplar least so; and that it is also thus with reference to the primitive vertical strength of the timber in the list. On referring to Iron-bark it will be seen, however, from the figures given, that its strength is superior, 1,557. We conclude our notice with a table which will give our readers an idea of the relative amount of timber imported into this country in 1849, and of the quarters from whence it came.

Timber	Loads	Deals	Teat	Staves	Lash wood
Brit. North America	578,748	468,572	9	45,614	14,813
Prussia	117,470	35,006		19,213	6,169
Russia	41,419	173,586		325	15,539
Sweden	28,679	79,843		150	1,119
Norway	28,930	50,805		95	103
United States	13,832	839		13,309	
Hanse Towns	2,441	68		1,012	
Tuscany	2,299	9			
Papal-Territories	2,106	3			
British Guinea	4	19	4	103	
Australia	977	540	1	4	
British India	1	2	17,459	56	
Western Africa	1		9,596		
Miscellaneous	1,002	491	633	36	57
Total loads	817,909	809,783	27,702	79,917	37,800

THE PRESERVATION OF TIMBER AND THE PREVENTION OF DECAY.

The various modes of seasoning and preserving Timber are of the first importance to the Practical Builder. The object to be attained in seasoning is to remove the sap, or the watery parts of the alburnum, in the recently formed layers of wood.

In the proportion that moisture and warmth exist, the more rapid is the decay of timber used in construction. Timber constantly dry will last an indefinite period, and some constantly wet will endure a long time; but few woods can long resist alternations of dryness and moisture. Those which do so best are fully described in a former section. The natural juices must be got rid of by seasoning, that the wood may become hard, dry, and fit for use. For this reason timber imported is generally formed into floats on the Thames and elsewhere, as the running water dilutes and washes out the juices in penetrating all the pores. As the water also does



Various methods of stacking timber.

not contain any quality to produce fermentation and is easily evaporated, the timber is greatly improved for building purposes. It should be thoroughly dried before being taken to the pit to be sawn. We have already mentioned how it should be stacked in the yard; and if cut into boards, these should be piled or put in a triangular form in such a manner that the air may circulate freely around. A few modes of stacking timber are illustrated on page 151. Of course the larger the pieces, the longer time will elapse before perfect seasoning. Salt water is preferred for ship timber, but it requires more time than fresh water to evaporate from the wood. Gradual drying is always preferable; the more gradual the better. It is of the utmost importance that timber should be thoroughly dried before it is cut into small scantlings, or a considerable amount of shrinkage will be the consequence, and it will also be much more liable to warp and twist. In water seasoning about a fortnight is sufficient time for the wood to be submerged. For the steaming and boiling process about four hours is the usual time for the continuance of the operation. Mr. Partington observes, — "If a piece of wood be boiled in water for a certain time, then taken out and immediately bent into any particular form, and it be retained in that form until it be dry, a permanent change takes place in the mechanical relations of its parts; so that, when relieved though it will spring back a little, yet it will not return to its natural form. The same effect may be produced by steaming wood; but though both these methods have been long practised to a considerable extent in the art of ship-building, we are not aware that any general principles have been discovered either by experiment or otherwise that will enable us to apply it to an art like joinery where so much precision is required. We are aware that it has been tried; but, before it can be rendered extensively useful, the relation between the curvature to which it is bent and that which it assumes when relieved should be determined, and also the degree of curvature which may be given to a piece of a stated thickness. For the joiner's purposes we imagine that the process might be greatly improved by saturating the convex side of each piece with a strong solution of glue immediately after bending it. By filling in this manner the extended pores and allowing the glue to harden thoroughly before relieving the pieces they would retain their shape better." Smoke-drying, scorching, and charring, are also processes applied to season wood, and when posts and piles are to be driven into the earth, charring is excellent; but to use it to green timber is very bad, confining as the operation does the juices which should be allowed to exude. The same excellent authority quoted above remarks. "The seasoning of timber by fire is the best way of all for piles and other pieces that are to stand under the earth or in water. The Venetians first found out this method, and the way by which they do it is this; they put the pieces to be seasoned in a strong and violent flame; in this they continually turn it round by means of an engine and take it out when it is every way covered with a thick coaly crust; by this means the internal part of the wood is so hardened that neither earth nor water can damage it for a long time afterwards. This method is practised in many places for seasoning the posts for palings in parks, etc. and has this to recommend it, that in the very oldest ruins we have ever been acquainted with, there have been discovered many times pieces of charcoal, all of which have been found uninjured, though buried in the earth for ever so many ages. This method of charring timber is practised in many parts of England, and has been much recommended both as to economy and effect. For this purpose all that is necessary is, to light a fire upon the ground which shall be surrounded by a wall built with loose bricks or stones, and then when the pieces of timber are laid across the walls, to turn them round carefully so as to present every part to the action of the fire in succession; and when the whole surface to the depth of three quarters of an inch, or an inch, is converted to charcoal, they will be sufficiently prepared. While burning, they should have a temporary covering of boughs or other fuel to preserve them from the action of the atmosphere, which would be apt to convert part of the wood into ashes. The most effectual mode of preserving timber from decay is to char it; but when the purpose to which it is applied will not

admit of that operation, the next best method is to wash it over with charcoal and water similar to whitewashing. Either of these methods will certainly preserve it from the dry-rot, charcoal being the greatest anti-putrescent known, and no moisture within the influence of its action will become putrid or decomposed, and we have already shown that this must take place before wood will perish. It may be further observed that vegetation cannot take place where charring or charcoal is used; the dry-rot is always accompanied with that species of vegetation called fungi, and this fungus never occurs till decomposition or decay has begun. When boarded floors are to be laid upon or very near to the ground, they should be strewed over with dry ashes and the joists and under sides of the boards either charred or payed over with charcoal-wash as before directed. The same method should be done with the side of wainscot next the walls. As from the fashion of the times painting is indispensable to doors, window shutters, wainscots, etc., it would be as well to have them painted at once in the carpenter's shop when the stuff is perfectly dry, and finished afterwards in the building for which they are prepared. If the best seasoned stuff be put up unpainted in a new building the quantity of moisture it will imbibe from the brickwork, plaster, etc. before it can be painted, will defeat all former care of well seasoning. As to sashes, mahogany is unquestionably the cheapest article they can be made of; for deal, when painted only a few times, will have cost more than the difference of price of that very superior wood both as to look and durability. Air that is stagnant is equally as pernicious as stagnant moisture. When it is in that state, it soon becomes decomposed, and the gas fixing upon wood, ropes, paper, and other vegetable substances, quickly brings on their destruction. Ventilation and the use of charcoal are the best preventors." The practice in Norway of seasoning deal planks by submerging them in salt water for a few days and then drying them in the sun, is defective and does not prevent their shrinking. Removing the atmospheric pressure and applying heat at the same time to assist evaporation has very many recommendations as a seasoning operation, but the expense and trouble of the apparatus will always prevent its general application. Mr. Evelyn recommended placing boards and planks in some running stream or pool for a few days to extract the sap and afterwards dry them in the sun: this preserves them from chopping, casting or cleaving, but not against shrinkage.

With regard to the rot, Tredgold observes — "a free evaporation determines it to be the wet rot; a confined place or imperfect evaporation renders it the dry rot, as timber must be decomposed before it can become the food of a plant; they are evidently the same with the putrefaction of the chemists." Mr. Gwilt, however, seems to think there is but little difference between the two. "They appear to be produced by the same causes, excepting that the freedom of evaporation determines the former, and an imperfect evaporation the latter. In both cases the timber is affected by a fungus-like parasite, beginning with a species of mildew, but how this fungus is generated is still a *vexata quæstio;* all we know is, that its vegetation is so rapid that often before it has arrived at its height a building is ruined. From our inquiries on the continent, we believe the disease does not occur to the extent it does in this country*; a fact which we are inclined, perhaps erroneously, to attribute to the use of the timber of the country instead of imported timber. Our notion is that our imported timber is infected with the seeds of decay long before its arrival here (we speak of fir more especially), and that the comparative warmth and moisture of the climate bring more effectually the causes of decay into action, especially where the situation is close and confined. Warmth is, doubtless, known to be a great agent in the dry rot, and most especially when moisture co-operates with it; for in warm cellars and other close and confined situations, where the vapour which feeds the disease is not altered by a constant change of air, the timbers are soon destroyed and become perfectly

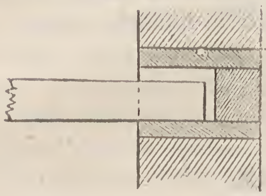
* In Leipzig, where it often appears, a case has lately occurred in which this fungus (or in German, Schwamm) had reached the second floor. *A. H. P.*

decomposed." To cure the rot, the fungus must be all scraped carefully off, not a particle being allowed to remain, or it will infect the rest. Coal tar has been afterwards applied, but its smell is an objection. Corrosive sublimate, a solution of vitriolic acid and pyrolignous acid, have been used with success. "A solution of sulphate of copper (commonly called blue vitriol) in the proportion of about half a pound of sulphate of copper to one gallon of water used hot makes an excellent wash" recommended by Tredgold. Against worms, Mr. Gwilt "believes nothing to be more efficacious than the saturation of timber with any of the oils; a process which destroys the insect if already in the wood, with that of turpentine especially, and prevents the liability of attack from it." Nitric acid, or sulphur immersed in aqua fortis and distilled, is recommended by Evelyn. Kyan's method, called Kyanising, consists in the application of a solution of corrosive sublimate, or bichloride of mercury, and is well known. This substance is prepared by dissolving red oxide of mercury in muriatic acid and evaporating the solution; there are also other modes of preparing it from the basis of mercury. Liebig thinks that its action is due to its combination with the lignum or woody fibre; but a portion of the corrosive sublimate must escape combination, for it has been detected at the depth of $1/8$ to $1/4$ of an inch by chemical tests, and even deeper by electrical testing. Timber thus treated is more brittle but has less flexibility and specific gravity than ordinary wood; Gwilt says of corrosive sublimate, — "Its poisonous qualities of course destroys all animal life with which it comes in contact, and we believe that our readers who are interested in preserving the timber of their dwellings may use a solution of it without infringing the rights of the patentee." Sir William Burnett recommends chloride of zinc as a preservative. Mr. J. Bethell has proposed oil of tar and other bituminous matters containing creosote: a crude solution of acetate of iron called pyrolignite of iron with creosote in solution; and gas tar free from ammonia. Mr. Payne's process consists in the application of sulphate of iron; but there would be no end to an enumeration of all the ingenious methods which have been advocated by scientific men. The simplest after all are probably the best. Evelyn believed, and we ourselves are inclined to think, that water seasoning is as good at least as any other mode, and if proper precautions are adopted the rot will rarely make its appearance. That decay of timber, first visible by its swelling and the formation of a fungus on it of a greyish white or brownish colour, would be of less frequent occurrence if the advice of Tredgold were invariably attended to: "for carpentry, timber should not be used in less than two years after it is felled and this is the least time that ought to be allowed for seasoning. For joiner's work it requires four years unless other methods be used; but for carpentry, natural seasoning should have the preference, unless the pressure of the air be removed."

The pile-worm or *Teredo navalis* is exceedingly destructive to piling and the timber work of bridges, piers, quays, etc., and its ravages may be often observed on the structures on the banks of the Thames. Smeaton says of a worm he remarked on Bridlington piers, — "This worm appears as a small white soft substance, much like a maggot; so small as not to be seen distinctly without a magnifying glass, and even then a distinction of its parts is not easily made out. It does not attempt to make its way through the wood longitudinally or along the grain, as is the case with the common ship-worm, but directly or obliquely inward. Neither does it appear to make its way by means of any hard tools or instruments, but rather by some species of dissolvent liquor, furnished by the juices of the animal itself. The rate of progression is that a three inch oak plank will be destroyed in eight years by action from the outside only." For resisting the depredations of this industrious creature, Smeaton proposed to fill all the openings of the piles with oakum and tar, to smooth the face, and case it with sheathing.

With respect to the arrangements of building in reference to the preservation of their wood work, two of the first requisites are that they should be thoroughly drained and ventilated, so that moisture may be prevented, and no damp rise through the walls. A small half-brick arch turned all round the building will go far towards remedying this latter evil, for it will prevent the earth

resting against the walls. A damp course above this formed with cement, slates, asphalte, gas tar, lead, or other appropriate materials, will aid the purpose in view; the damp course at least should never be neglected where the least suspicion of moisture exists. The sunk stories of houses must invariably be surrounded by open areas of the whole length of the part excavated and as wide and open as possible; if the ground is sloped towards them, a free current of air would be promoted. The carcase of the house, as soon as roofed over, should be left as long as possible to dry before the finishings are added, so as to allow the timbers to get settled to their proper bearings and avoid undue sinkings, cracks in plastering, etc.: this forms what is termed a second seasoning. Evelyn says, — "Timber that you have occasion to lay in mortar, or which is in any part contiguous to lime, as doors, window cases, ground sills, the extremities of beams, etc., have sometimes been capped with molten pitch as a marvellous preserver of it from the burning and destructive effects of the lime; but it has since been found rather to heat and decay them, by hardening the transudation which those parts require; better supplied with loam or strewings of brick dust or pieces of boards; some leave a small hole for the air. But though lime be so destructive, whilst timber thus lies dry, it seems they mingle it with hair to keep the worm out of ships, which they sheathe for southern voyages, thought it is held much to retard their course." It is an excellent practice to rest the ends of beams usually built up and surrounded with lime in the wall, in the manner shown; by this means there is a free circulation of air around, tending much to prevent that too common decay commencing at the ends of timbers, and all danger of settlement arising from the pressure of the superincumbent materials on the compressible and decaying wood is in a great measure nullified. In reference also to the injurious effects of lime Tredgold observes, — "Quicklime, assisted by moisture, has a powerful effect in hastening the decomposition of wood, in consequence of its abstracting carbon. Mild lime (carbonate of lime) has not this effect. But mortar requires a considerable time to bring it to the state of mild lime; therefore bedding timber in mortar, or building it in walls, where it will long remain in a damp state in contact with mortar, is very injurious, and often the cause of rapid decay. — Wood in a perfectly dry state does not appear to be injured by dry lime: of this we have examples in plastering laths which are generally found sound and good in places where they have been dry. Lime also protects wood from worms. Volatile and fixed oils, resin, and wax, are equally susceptible of decay as woody fibres under the same circumstances; hence, we see the impropriety of attempting to protect wood in any situation where the coat of paint, etc. cannot be renewed from time to time, and also that woods abounding in resinous matters cannot be more durable than others." If pitch, tar, or paint is applied before the wood is seasoned, decay must ensue from the forcible confinement of the juices which ought to have been previously allowed to evaporate; and, for the same reason, painted floor cloths which prevent the access of atmospheric air, are similarly injurious; carpets however necessary, are detrimental if placed over boards insufficiently seasoned. Timber not painted will be often found to last longer than that so covered; and this has been observed in many instances when the painted portion was rotten sooner than the exposed part. The carpenters in the Middle Ages generally repudiated paint, preferring the natural appearence of the wood used to any artificial imitations, conveying to the mind a false idea of the nature of it. They were more truthful than we are; and in many old baronial halls and in many a quiet sequestered village church their handiwork still endures, and the havoc and wear of five centuries have made comparatively little inroad on the durability of the wood framings. The undressed elm weather-boarding of old English barns has a hard external surface acquired in the course of time, and to which it owes its duration; it is apparently a coating of silica, impervious to moisture; and so hard that it resists the edge of a sharp tool. Mr. Cresy expresses his opinion, that this "silica may be derived from the decomposition of wheat straw with



which the barns are usually thatched." The Dutch preserve their gates and draw-bridges by coating them with a mixture of pitch and tar, with pounded shells, sand, and ashes strewed upon it. Semple says, in his treatise on Building in Water, — "after your work is tied up, or even put together, lay it on the ground, with stones or bricks under it to about a foot high, and burn wood (which is the best firing for the purpose) under it, till you thoroughly heat and even scorch it all over; then, whilst the wood is hot, rub it over plentifully with linseed oil and tar, in equal parts, and well boiled together, and let it be kept boiling while you are using it; and this will immediately strike and sink (if the wood be tolerably seasoned) one inch or more into the wood, close all the pores and make it become exceedingly hard and durable either under or over water." Sanding painting is a most excellent practice; a coating composed of a mixture of sub-sulphate of iron ground in oil and made fluid with coal-tar mixed with pitch is recommended by Chapman.

We could wish to add more on this interesting and useful subject did our limits allow us to do so. We think, however, we have sketched out all the more prominent information with which it is absolutely requisite that the Builder should be familiar; and those who desire to go further into the matter are referred to the several authors whose valuable works have been quoted.

DESIGN FOR A DETACHED TOWN HOUSE.

PLATES 50. 51.*

The accomodation provided in this design comprises an Entrance Hall, and Hall, open Staircase with Stairs to Basement, all well lighted and roomy. A door opens into a lobby leading to W. C. and covered Verandah, with steps to the Garden. A China Closet is placed five steps up the stairs. The rooms on the Ground Floor consist of

A Drawing Room with three windows	20′ „ 6″ × 12′ „ 0″
A Dining Room, communicating by means of folding doors with the Drawing Room . . .	14′ „ 0″ × 10′ „ 6″
A Library, or Breakfast Parlour	12′ „ 6″ × 7′ „ 6″
A Conservatory, communicating with the Library and Dining Room	10′ „ 9″ × 8′ „ 0″

The ground is not to be excavated under the Library and Conservatory except for the heating apparatus (if requisite). The Basement is to have a Kitchen, Scullery, Larder, Pantry, W. C. Closets, Area at back, with steps up to Garden. The door to the heating apparatus will be in the Scullery, and the Coals kept there. The first Floor contains

A Front Bed Room . . .	14′ „ 0″ × 12′ „ 0″
A Dressing Room . . .	12′ „ 0″ × 5′ „ 0″
A Back Bed Room . . .	10′ „ 9″ × 10′ „ 9″
A Front Bed Room . . .	9′ „ 0″ × 8′ „ 6″
A Nursery, or Dressing Room	12′ „ 6″ × 7′ „ 6″
W. C. and Closets.	

The Attic Floor contains four good secondary Bed Rooms and two large Closets, but this floor may be divided and appropriated as convenient. The roof slopes into the rooms and they are lighted by small dormer windows. The Ground Floor is raised 3 feet above the level of the ground, and is 11′ „ 3″ in height; the Basement is 9 feet high, the First Floor 10′ „ 6″ and the Attic Floor 7′ „ 6″ in the clear.

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* For description of Plate 46. 47. 48 see Page 61 and for description of plate 49 see Page 66.

The Elevations depend for their effect on the contrasted use of red and yellow bricks, stone and cement work being avoided. It is always desirable to use real material instead of counterfeits. Of these latter cement is one we can never look at with satisfaction, it is very rarely so executed as to really look like that which it would appear, viz: stone, and the colour is usually so intensely disagreeable, and the material itself so flimsy in effect, and so suggestive of a false and patching economy, of an aim after finery, when beauty cannot be attained, that we would, if we were able, altogether abolish its use. Another objection to cement is, that it is usually a coating to the most inferior work and bricks so crumbling and unsightly that, if they were to appear, they could not be employed. Now an infinitely better and more pleasing effect than that of cement, one which we venture to say will more readily please in nine instances out of ten, consists in the proper contrasting of bricks of various colours. This is at once productive of a cheerful effect, is economical, tends to prevent the introduction of bad bricks, and is infinitely more *truthful*, and therefore more in accordance with the rules of good taste than any ridiculous imitations and counterfeits of stone work. But it may be said on the other hand, that brick is a common material. Nations, however far superior to us, did not think so, but, on the contrary, saw that brickwork was preferable for exterior use to any species of plastering. Mr. Hope remarks in his Historical Essay on Architecture that "the ancient Romans, whenever they found clay more abundant or easier to work than stone, used it plentifully both in regular layers throughout the body of walls, as we do, and as an external reticulated coating is from the fineness of its texture and the firmness of its joints, as durable as stone itself. Indeed, far from considering brick only as a material fit for the coarsest and indispensable ground work of architecture, they regarded it as equally fit for all the elegancies of ornamental form, all the details of rich architraves, capitals, freizes, cornices, and other embellishments. Sometimes it owed to the mould its various forms, and at others, as at the Amphitheatre Castrense and the temple of the God *Ridiculus* to the Chisel." In Pavia in the North of Italy we see bricks used in all the delicate tracery of the Middle Ages, and at Milan for the arabesques and scroll-work of the cinque-cento style. In the South of France, more especially at Toulouse, remarkable instances of ornamental brickworks exist; and along the Rhone carved tiles are formed into very elegant cornices and balustrades. In England, however, cement is apparently considered extremely beautiful, and the elegant moulded and carved brickwork would probably be thought excessively vulgar. We content ourselves, however, with just indicating our ideas on the subject, and we have no doubt the few hints we have given, will be sufficient to disabuse the minds of many of our readers of the prejudice existing in favour of the combined beauty and utility of cement. The walls of the Elevations given, may be of ordinary stock bricks (25 shillings per thousand) or faced with Yellow Malms (£ 2 „ 5 „ 0 per thousand) or of white Suffolk Bricks (£ 2 „ 15 „ 0 per thousand) all neatly pointed with a neat flat parallel ruled joint. The Red Bricks may be Kentish Red bricks (£ 2 „ 5 „ 0 per thousand). The arches to be all turned in half brick rings, bonded through with a whole brick, where the joints meet; the skewbacks to be accurately cut and all axed and tuck-printed or gauged rubbed and set in putty or cement. The cornices are to be formed in brickwork, cut and moulded, with blocks, as shewn, and neatly pointed. The cost of the house, if built of stock and Kentish red bricks, will be within £ 800.

We shall here resume our miscellaneous remarks on the arrangements and fittings of domestic habitations, and we cannot do so better than by a quotation from a quaint old author before cited, Dr. Fuller, prebendary of Sarum. "First, let not the common rooms be several nor the several rooms common; that the common rooms should not be private or retired as the hall, galleries, etc. which are to be open; and the chambers, closets, etc. retired and private, provided the whole house be not spent in paths. Light (God's eldest Daughter) is a principal beauty in a *building;* yet it shines not alike from all parts of the heavens. An east window gives the infant beams of the sun before they are of strength to do harm, and is offensive to none but a sluggard. A south

window in summer is a chimney with a fire in it, and stands in need to be screened by a curtain (or outside blind, our author should have said). In a west window the sun grows low, and over familiar towards night in summer time, and with more light than delight. A north window is best for butteries and cellars, where the beer will be sour, because the sun smiles upon it Through lights are best for rooms of entertainment and windows on one side for dormitories Secondly as to capaciousness, a house had better be too little for a day than too big for a year, therefore houses ought to be proportioned to ordinary occasions and not to extraordinary. It will be easier borrowing a brace of chambers of a neighbour for a night, than a bag of money for a year, therefore 'tis a vanity to proportion the receipt to an extraordinary occasion as those do who, by overbuilding their houses, dilapidate their lands, so that their estates are pressed to death under the weight of their houses. As for beauty, let not the front look asquint upon a stranger, but accost him right at his entrance. Uniformity and proportions are very pleasing to the eye; and 'tis observable that freestone like a fair complexion, grows old, whilst bricks keep their beauty longest."

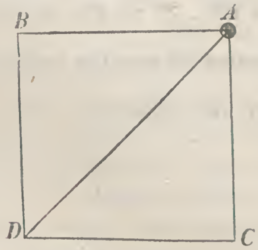
We shall now continue our former observations with some remarks on doors. These must be of sufficient size, and so proportioned to allow a free passage through them; thus internal doors should be 2′ „ 9″ to 3′ „ 6″ wide, and folding doors from 4′ „ 6″ to 7 or 8 feet. Entrance doors ought to be from 3′ „ 6″ to 5 feet wide in the clear, and the height of all not under 6′ „ 10″ or 7 feet, so that a tall person can easily enter with his hat on without stooping. Houses of a superior class will of course have their doorways proportionately increased. All doors should open inwards, as, if they are otherwise hung, the person entering pulls the door towards him, which is awkward and inconvenient. When the width of a door is above 3′ „ 6″ it is preferable to have two doors hung folding, because they do not then occupy so much space in the sweep, on opening, each door is lighter, and they will both more readily fold back than a single one. The entrance door should be conspicuous and present itself readily to view, and two entrance doors in the same front ought to be avoided, as the visitor will be at a loss to know at which to present himself. We have before made a few remarks on the relative situations of internal doors, and we may add that if opposite one another, ventilation is greatly aided and a suite of rooms is shown off to full advantage. In the article on Smoky Chimneys we have explained the disadvantage of doors placed on the same side of the room as the fireplace; a number of doors in one room should be avoided on account of the draughts of air and the cold consequently induced. It has not come within the scope of this work to make any remarks on the ornamental dressing of doors, and indeed it would require very great space to enter at all into this subject. In the article on joinery some observations will be made on the construction and framing together of doors, together with the mode of hingeing or hanging them; in the latter the clearing of the carpet is an essential requisite.

Staircases next demand our consideration. They should be at once accessible on entering the house and be amply lighted, for it must be sufficiently obvious that an excess of light is a smaller defect than a deficiency. Palladio, an author to whom we may safely refer, remarks of staircases, — "A particular place must be marked out that no part of the building should receive any prejudice by them. There are three openings necessary to a staircase. The first is the doorway that leads to it, which the more it is in sight the better it is, and I highly approve of its being in such a place that before one comes to it the best part of the house may be seen; for although the house be small yet by such an arrangement it will apear larger: the door, however, must be obvious and easy to be found. The second opening is that of the windows, through which the stairs are lighted; they should be in the middle and large enough to light the stairs in every part. The third opening is the landing place, by which one enters into the rooms above; it ought to be fair and well ornamented and to lead into the largest places first. Staircases will be perfect if they are spacious, light, and easy to ascend; as if indeed they seemed to invite people to

mount. They will be clear if the light is bright and equally diffused, and they will be sufficiently ample, if they do not appear scanty and narrow, in proportion to the size and quality of the building." Staircases are divided into several varieties. A *Doglegged* Staircase has no opening or well hole, and the rail and balusters of both the progressive and returning flights fall in the same vertical planes; the steps are fixed to newels, strings and carriages, and the ends of the steps of the inferior kind terminate only upon one side of the strings without any housing. A *Bracket Staircase* has an opening or well, with string and newels, and is supported by landings and carriages. The brackets are mitred to the end of each riser and fixed to the string board which is usually moulded like an architrave. A *Geometrical Staircase* is one in which the steps are supported by having one end fixed in the wall, each having also an auxiliary from the steps immediately below it and the lowest one next the floor. Stairs are also divided into two sorts *straight* and *winding.* Straight stairs are always such as *fly*, or proceed in a right line and never wind. Direct or plain fliers go direct from one floor to another without any turn and are used for cellar and garret stairs. Square fliers fly round the sides of a square newel, either open or solid, having at every corner a square half step occupying one fourth of a circle. Triangular fliers fly round the sides of a triangular newel, either solid or open, and having at the corner of the newel a tapering half steps occupying two-thirds of a circle. What are termed French fliers, fly directly forwards, and then have a square landing place from which you ascend to another, and then to another parallel to the first flight and so on. Winding stairs never fly. There are circular, square, and triangular varieties of these, winding round newels, circular, square or triangular, either solid or open. For very narrow circular stone stairs the proper size of the newel is $^3/_6$ to that of the staircase and increased in proportion. For open circular newels Palladio recommends that the newel be one half the diameter of the staircase. Mixed stairs partly wind and partly fly and include those first described. We shall conclude our observations on staircases by quoting some remarks by Mr. Gwilt on the subject. "It is a maxim that a broad step should be of less height than one which is narrower; and the reason is sufficiently obvious, because in striding, what a man loses in breadth, he can more easily apply in raising himself by his feet. Now, as in common practice, it is found that the convenient rise of a step 12 inches in width is $5^1/_2$ inches, it may be assumed as some guide for the regulation of other dimensions. Thus $12 \times 5^1/_2 = 66$, which would be a constant numerator for the proportion. Suppose, for instance, a step 10 inches in breadth, then $\frac{66}{10} = 6^3/_5$ inches would be the height; and this agrees very nearly with the common practice. The breadth of steps in the commonest staircase may be taken at 10 inches at a medium. In the best staircases the breadth of the step should not be less than 12 inches, neither should it be more than 18 inches. Having adjusted the proportion of the step, our next consideration is to ascertain the number of risers which will be necessary to carry us from one floor to another. Suppose, for example, the height from the top of one floor to that of the next be 15 feet $=$ 180 inches; here, if the steps are each of 6 inch rise, we have $\frac{180}{6} = 30$, which is the number of risers necessary to ascend from floor to floor. If the height divided by the rise of each step should not give an exact number of risers, it is better to add one rather than diminish the number. Thus suppose the distance from floor to floor to be 13′ „ 2″ = 158 inches then $\frac{158}{7} = 22\frac{4}{7}$. Here it would be better to take 23 risers, for the steps must be equal in height. On the construction of staircases we shall speak when treating on Joinery and Masonry

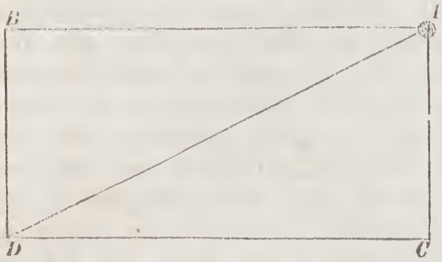
THE MECHANICAL PRINCIPLES OF CARPENTRY.

The fitness of different substances for mechanical purposes and their degrees of strength depend on a certain force which is in them, and by the operation of which their particles keep their relative positions and adhere, or, as it were, stick together. This is one species of *attraction* termed the attraction of cohesion. It acts only at insensible distances: unlike that of gravitation, which urges separated bodies towards one another; of capillary attraction, causing liquids to rise in tubes; of chemical attraction, making different substances unite into a new one; of electrical attraction, excited by friction in certain bodies; and of magnetic attraction, causing the needle to point towards the poles of the earth. Attraction of cohesion, on which we have more particularly to treat, is much more powerful in some bodies than in others; more so generally in metals, than in other building materials. We know that in these the particles are at a distance from one another, and that they are kept in their due relations by the antagonistic forces of attraction, and repulsion; the latter understood more or less by the name of heat or caloric, the nature of which is unknown, except from its effects. Mechanics is the name given to the science, which treats of the action of combined bodies on one another, and of the application of the laws of motion and forces to contrivances in the arts. Statics is a branch of mechanics treating of the equilibrium of solids; dynamics considers them in motion; hydrostatics and hydraulics refer severally to fluids at rest and in motion; and aëriform fluids in their height, pressure and motion belong to pneumatics. With statics alone have we now to do: and the main purpose required in the mechanical operations which we shall proceed to consider, is to overcome, sustain, or oppose a certain resistance or force. As is remarked in the Encyclopædia Britannica, in the very justly celebrated article on carpentry, seven different varieties of the effects of forces may be distinguished; — "the extension of a substance acting simply as a tie; the compression of a block supporting a load above it; the detrusion of an axis resting on a support, close to its wheel, and resisting by its lateral adhesion only; the flexure of a body bent by a force applied unequally to its different parts; the torsion or twisting arising from a partial detrusion of the external parts in opposite directions, while the axis retains its place; the alteration or permanent change of a body, which settles, so as to remain in a new form, when the force is withdrawn; and lastly the fracture, which consists in a complete separation of parts before united, and which has been the only effect particularly examined by the generality of authors on the strength of materials." The carpenter has to consider, 1st, what is the strength of his materials and the amount of strain to which they will be subjected; 2nd, in what manner this strain may be modified by the disposition of the several timbers: 3rd, having done all this, what are the best forms of joints and other connexions. The first essentials to be understood, the very alphabet as it were, of carpentry, are the laws relating to the *composition and resolution* of forces. Let us endeavour to make these clear and simple. If two or more forces act at the same moment on any



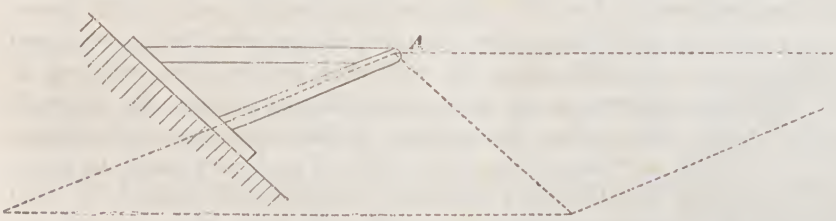
given part of a body at definite angles, a single impulsive force may be found which will produce the same effect; this is called technically the *resultant* or *equivalent*. For instance, if a body at A be pressed upon at the same time, with equal intensity, in the directions $A\,B$, $A\,C$, it will, if there is no counterbalancing force, be urged in the direction of the diagonal or equivalent $A\,D$; and a single force pressing in this direction would produce the same effect as the other two forces. A square is perceived to be the result of the developement of these forces.

If however the forces pressing on the body *A*, are of unequal intensity, the force pressing in the direction *A*, *B*, being twice the intensity of that in the direction *A C*, the form described will be a parallelogram, the length of its lines exhibiting comparatively the forces, when we draw all the lines connected with the experiment. The two forces acting in the direction *A B*, *A C*, are called *components*, and the single force *A D*, *the resultant*. The process of finding the single force is termed the *composition of forces*, and that of finding two forces equal to a single one is called the *resolution of forces;* or, in other words, the *resolving* of the force *A D*, into *A B*, *A C*.

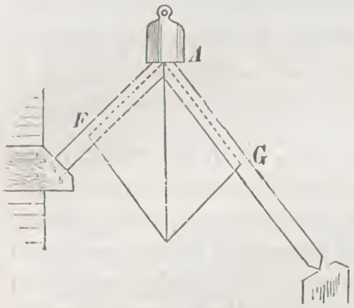


We will now illustrate this simple matter and apply it to carpentry by stating the mode of resolving forces, or finding whether two given forces, or pressures, are sufficiently strong to answer their object—that is, to act together as one force would in the direction of their diagonal.

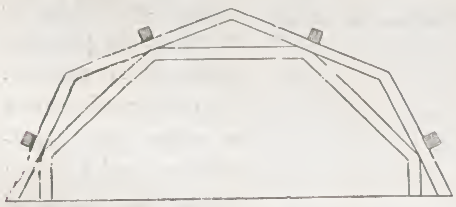
Let *A B*, (see plate II. fig. 1.) be the king post of a roof, and *A C*, *A D*, the rafters, and we wish to ascertain whether they are sufficiently strong to carry the weight imposed upon them. Draw the dotted central line *A B*, representing in length the integer, or number of pounds resting, or pressing, at *A*; draw also the dotted lines *A C*, *A D*, parallel to the respective rafters, and similarly connect *B C*, *B D;* the points of intersection at *C* and *D*, determine the weight resting on each rafter; for if *A B*, represents the number of pressing pounds at *A*, the result of the combination of rafters is that the dotted line *A D*, represents in proportion to *A B*, the number of pounds resting on the one rafter and *A C*, the weight by which the other is strained. The fact of one rafter being longer than the other does not at all affect the relative distribution of the weight, but the effects of the strain are of course modified by the length of the piece on which it is exerted. The compression must be taken into consideration, and a rafter double the length of another will be compressed twice as much; therefore the scantling must be increased in proportion. If the angle of the rafter is varied (as in fig. 2.) the pressure will be differently distributed from that in fig. 1. as will be perceived by drawing the dotted lines in the manner described. In fact the more obtuse the angle of the rafters, the greater is the strain exerted upon them: a very obtuse angle sustains an enormous proportionate amount of pressure, and a comparatively slight alteration will make a considerable difference in the strength of the combination. Of course, if the slopes are equal on both sides, the straining force is equally distributed, and roofs are usually constructed thus; if the timbers are inverted and each beam is pulled in the opposite direction, the proportionate strains are just as described, and the same formula applies. If the form of the framing is changed as in Fig. 3. much the same result is the consequence, but the strains are increased or diminished in proportion to the character of the angle; if it is as in the margin, an enormous strain is the result; and, as above remarked, the more obtuse or open the angle *A* against which the force presses, the greater are the strains exerted on the timbers forming the sides of the angle. "All calculations about the strength of carpentry are reduced to this case; for when more ties or braces meet in a point (a thing that rarely happens) we reduce them to three by substituting for any two the force which results from their combination, and then combining this with another, and so on." It is of the highest



importance not to mistake the *character* of the desription of strain, which is exerted on any piece of timber and the following rule is given by Dr. Thomas Young for distinguishing between a strut and a tie. "Take notice of the direction, in which the piece acts, from which the strain proceeds. Draw a line in that direction from the point on which the strain is exerted, and let its length (measured in some scale of equal parts) express the magnitude of this action, in pounds, hundreds, or tons. From its *remote* extremity draw lines parallel to the pieces, on which the strain is exerted. The line parallel to one piece will necessarily cut the other or its direction produced. If it cut the piece itself, that piece is compressed by the strain, and it is performing the office of a strut or brace; if it cut its direction produced, the piece is stretched and it is a tie, In short the strains on the pieces *A C, A D,* are to be estimated in the direction of the points *F*, and *G*, from the strained point *A*. In general, if the straining piece is within the angle formed by the pieces which are strained, the strains which they sustain are of the opposite kind to that which it exerts. If it be pushing, they are drawing; but if it be within the angle formed by their directions produced, the strains which they sustain, are of the same kind. All the three are either drawing or pressing. If the straining piece lie within the angle formed by one piece and the produced direction of the other, its own strain, whether compression or extension, is of the same kind with that of the most remote of the other two, and opposite to that of the nearest."



A triangle, we may observe, is the sole figure the form of which cannot be changed without altering the proportion of the sides, and which cannot therefore yield without separating its angles, or tearing asunder its sides; all frame work should be constructed on a system of triangles, or be divided by them into ties, and struts. The triangular form is given to the framework supporting the parts of a wooden bridge, or a roof of wide span, by combining two or more polygons of beams, as in the *principal* in the margin. By infinitely increasing the number of these polygons and keeping the dimensions of the sides of each very small, the frame will become a continuous wooden arch, formed of small timbers bolted together with joints across; and this species of timber arch has been frequently used, as in that of the Riding House in Moscow, 235 feet span, and a bridge near Portsmouth, U. S. 270 feet span and 27 feet high. A *truss* is a system of framing employed to increase the strength of a single beam, which is then said to be trussed; or, as it has been defined, any arrangement of timbers to support a weight by their direct or lengthways strength; that is by compression and tension, without liability to flexure; and this is the only scientific mode of combining fibrous materials to support roofs, bridges, etc. The comparative strength of any form of framework, or truss, which can be easily secured by increasing the scantlings of its parts is of less importance than its *stiffness*, or resistance to any change of form; but it is an universal axiom that the strength of every system of framing must be estimated no higher than that of its weakest part. These remarks would lead us to the construction of roofs, but we prefer to offer a few observations on them under another heading. Timbers being employed to resist very considerable strains and to carry great weights, it becomes important to ascertain the laws which regulate their power of resistance to tension and pressure, under different circumstances; as unless these laws are carefully studied, it will be impossible for the practical builder to determine the relative scantlings of the timbers used in constructing trusses and other combinations. The skill of the carpenter is shown in selecting timbers of sufficient size safely to bear the weight imposed



without employing pieces either too largeor too insufficient for the purpose required. The value of wood for constructive purposes can hardly be overrated, and its preferableness to iron and stone arises from its strength united with extraordinary lightness. Thus, deal is only one fifteenth the weight, of cast iron, while it has much more than one half the tenacity; and the weight of sixteen slips of it would only be equal to one of the same dimensions of wrought iron, although, together, their united strength would be equal to three of the latter. The liability of wood to combustion has of late years caused iron to be extensively substituted for it; but timber constructions will always be preferable in many situations, as well for reasons of convenience and economy, as that its tension and durability are such that very considerable weight may safely be trusted to it.

The strength of wood is proportioned to its weight and density, the heaviest being usually the strongest; and after it has lost about one sixth of its weight when felled, it is considered fit for building purposes. Now the strength of timber is considered both *absolutely* and *relatively*. The *absolute* strength of timber is measured by the degree of exertion that is necessary to pull it asunder lengthways, in the direction of its fibres; while the *relative* strength of a beam depends, as the term implies, on the position in which it is placed with reference to other timbers.

Thus, if a piece of wood is placed upright, it is more difficult to break than if a weight were suspended upon it laid horizontally with the two ends supported; and still less so if one end is fixed and the other unsupported. With respect to the absolute strength of timber we need say little here. It is not often that its consideration becomes of very great importance, iron tie rods being substituted for timber whenever there is a considerable liability in ties to be stretched in the direction of their lengths. Mr. Barlow ascertained that the force necessary to separate the parts of a piece of deal by causing them to slide one upon another in the direction of the fibre to be about 5 cwt. to the square inch, and for oak about $82^1/_2$ cwt. When, however, the force was applied perpendicular to the direction of the fibre, $20^1/_2$ cwt. per square inch was requisite to destroy the cohesive power of oak, 15 cwt. for poplar, and $8^1/_2$ to $15^1/_2$ cwt. for larch. Rondelet found that the absolute strength of oak was 110 lbs. for every $\frac{888}{1,0000}$ of an inch area; and the following table from Mr. Gwilt's Encyclopædia is all that under this head we deem needful to lay before the reader.

A small rod of oak 0,0888 inches square and 2. 14 inches in length broke with a weight of	115	lbs. avoirdupois	
Another specimen of the same wood, and of similar dimensions, broke with	$105\frac{8}{10}$	lbs.	„
Another specimen	$110\frac{1}{10}$	„	„
The mean weight therefore was in round numbers	110	„	„
A rood of the same wood as the former 0.177 inch square and 2.14 long broke with a weight of	$439^1/_2$	„	„
Another specimen	418	„	„
Another specimen	$451^1/_2$	„	„

The mean weight therefore was 436 lbs. for an area $\frac{35}{100}$ in.

The result of all experiments was as before indicated.

With regard to timbers placed horizontally and their power to resist a transverse strain, it is observed, that, if supported at the ends, the liability to fracture does not decrease strictly in the inverse ratio of the length, when the thicknesses are equal; or, in other words, the strength does not diminish exactly in proportion to the distance of the bearings between the points of support. Buffon's experiments prove that a beam twice as long as another, the scantlings being the same, will not bear half the weight carried by the latter; or a piece 1 foot square and 10 feet long, placed in a horizontal position and carried at both ends, will bear more than double the weight of another of the same section and 20 feet long. In beams whose bearing is equal between the points of support, their strength is as their width and the squares of their depth; and it is clear from the above named philosopher's experiments that, "owing to the elasticity of the timber, the strength of the pieces instead of forming a decreasing geometrical progression, whose exponent is the same, forms one in which it is variable. The forces in question may be represented by the ordinates of a species of catenarian curve." Dr. Young remarks that the transverse strength of a beam is directly as the breadth and as the square of the depth, and inversely as the length; and the variation of the results of some experiments from this law can only have depended on accidental circumstances. If we wish to find the number of hundred weights that will break a beam of oak supported at both ends, supposing them to be placed exactly on the middle, we may multiply the square of the depth in inches by 100 times the breadth and divide by the length; and we may venture in practice to load a beam, with at least an eighth as much as this, or in case of necessity even a fourth. And if the load be distributed equally throughout the length of the beam it will support twice as much; but for a beam of fir the strength is less than for oak. A cylinder will bear the same curvature as the circumscribing prism, and it may be shown that its strength as well as its stiffness, is to that of the prism as one fourth of its bulk is to one third of the bulk of the prism. "When a beam is fixed at both ends and the weight is placed on the centre, its strength is as 3 to 2 to that when it is only supported at the extremities. When the pressure is uniform all over the length, the beam is only half as liable to fracture as it is when concentrated at the centre; and we thus see the importance of supporting trussed timber in the middle. Bellidor, in his "Science des Ingenieurs" asserts that a beam firmly fixed at both ends is not twice the strength, as when simply lying on its supports; but although Pitot agreed with him, Dr. Young is of a different opinion, considering that Bellidor's experiments are too imperfectly described to be of much value. The stiffness of a beam, is the proportion between its deflexion, or sagging, and its length; and this curvature should never be allowed to exist to a greater degree than $\frac{1}{480}$ of the length or $\frac{1}{40}$ inch to a foot. The mode of finding how much a beam of fir will deflect if it is pressed in the middle, is to multiply the cube of the length in inches by the given weight in pounds, and divide by the cube of the depth and by ten million times the breadth; but it is probable that, from the want of uniformity in the texture of the wood, the bending will be found practically to be more than this result: a beam of oak also sinks somewhat more than one of fir of the same weight. The neutral axis or point in a beam, is that part where, in fracture, the extension terminates and compression begins, as shown in the diagram;

it is there seen that the particles in the convex side are stretched and those in the concave brought closer together, until the former pass beyond their attractive or cohesive distance and separate at the part which is most stretched. The fracture is really one of *tension;* and, as throughout the neutral axis, there is neither extension nor compression, its cohesive power is not affected, and the beam would be just as effective if a hole were bored through this axis. It must be evident, that when we speak of the strength of a beam, we mean only its resistance to compression on one side and to ex-

tension on the other; and these will depend on *the cohesive power of the wood, its shape, the weight imposed, and the unsupported length of the beam.*

Of the value of the cohesive strength of rods of wood, one inch square, we give the following table from Cresy's Encyclopædia of Civil Engineering, and our readers can thus judge for themselves in choosing timber best suited to the proposed purposes. The rods were one inch square exposed to a transverse strain.

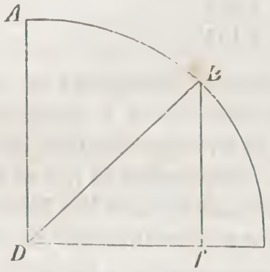
Alder	1,590	Larch	1,896
Ash	2,355	Larch, very young	966
Acacia	1,866	Mahog. Spanish .	1,275
Beech	1,556	Mahog. Honduras	1,911
Chesnut	1,350	Oak	1,672
Elm	1,620	Oak, Canadian .	1,766
Fir, Riga . . .	1,590	Oak, Dantzic . .	1,457
Fir, Memel . . .	1,635	Pine, pitch . . .	1,632
Fir, Norway . .	2,376	Pine, red . . .	1,341
		Poplar	981
Fir, Scotch . .	1,746	Plane	1,821
Fir, New England	1,102	Sycamore . . .	1,608
Fir, Spruce . .	1,395	Teak	2,151

In the article on Timber used in Building Operations, we gave a diagram illustrative of the mode of cutting the strongest piece of wood from a tree. It is easy also to cut a beam one half through without any diminution of its strength, but rather adding to it; this was first done by Du Hamel. The resistance of the compressed side of a beam to compression is not at all altered by cutting it through, if it is cut only so far as the compression reaches; and Du Hamel found that so far from its strength being impaired by cutting it three quarters through on its compressed side, and filling up the saw cut with a harder wood, its resistance to a strain was materially increased. The compressed portion of a beam extends to about five eighths its depth, and to this extent it may be cut without alteration of its strength. Wood, unlike metal, requires less force to crush it than what is demanded to tear it asunder. Respecting the shape of timber, Mr. Cresy remarks, "Rectangular pieces of timber have their centres of gravity in the centre of their dimensions; a piece of timber 12 inches by 12 contains 144 square inches, and its centre of gravity will be six inches from each side; if the piece be broken by any load its fracture will terminate at the upper surface, or 6 inches above the centre of gravity. The area 144, multiplied by 6, gives 864 as the lateral strength, which may be applied in comparison with any other scantling of different dimensions on wood of the same quality; saw this piece of timber down the middle; the centre of gravity remains the same, if the sides are in the same vertical position, the area of the section of each is 72, and this multiplied by 6, the distance of the centre of gravity from the upper surface makes half the product obtained before the timber was sawn; it is apparent, then, that, the depth remaining the same, the strength varies as the thickness; should the position of these latter timbers be reversed, that is placed flat, instead of on edge, the centre of gravity then is only three inches below the upper surface: the area of the end 72 being multiplied by 3, we obtain only 216 as the product, which is only half the strength it had, placed edgeways. The scantling, which has the greatest strength is not all square, but that with the same area, which has its centre of gravity farthest from the top; a piece of timber 14×10 inches, squares to 140 inches, and contains less than a piece of 12×12 or 144 square inches; but the centre of gravity of the first is 7 inches from the top, and 140 multiplied by 7, produces 980, which exceeds $144 \times 6 = 864$.—This is further illustrated by a plank 10 inches in depth and 1 inch in thickness; the sectional area 10 inches, multiplied by 5, the

distance in inches of the centre of gravity from the upper edge, the product is 50; the same piece placed flatwise must only be multiplied by $^1/_2$ inch, the product than is only 5, consequently the plank, when placed on edge, is ten times stronger that when placed flatwise."

Of the length of beams and the manner in which their strength proportionately diminishes, we have before spoken; it now only remains to give the rule to find the weight, which, placed on the centre, will fracture a piece of timber supported at both ends. The reader will refer to the table given of the cohesive strength of different woods, and multiply the breadth of the beam by the square of the depth, and again by four times the constant value; the product, if divided by the length in inches, will give the required weight.

The strain on a piece of timber fixed at one end and loaded at the other, is four times greater than when the same weight is placed on the middle of the beam; and the strain occasioned at any section between the points of weight and support is proportional to the product of the number of pounds or hundreds, and the number of feet and inches, etc. between the particular section and the weight.



With regard to the strength of struts and braces, if a vertical piece of timber *A D*, be gradually inclined, its strength, when thus, is exactly proportionate to its degree of inclination. A vertical piece has the greatest comparative strength to resist weight or pressure; the weakest are those pieces which lie in a horizontal direction; the medium are struts; their relative strength may be thus obtained. If from the upper end of the strut *B*, a vertical line be dropped till it touches at *f* one drawn horizontally from the base *D*, of the upright, the strength of the strut will diminish in proportion as the length *D f* increases. Thus it results, that the strength of a piece of vertical timber is to that of an inclined piece, of the same scantling, as the length of the former *A D*, is to the horizontal line *D f*; or as the radius is to the sine of the inclination of the strut. The stiffness of timber, or its resistance to any modification of shape, is of far more importance than its comparative strength; and we must, as before observed, always base our estimates on the consideration of the *weakest* part of any description of framework. It is the flexibility of timber which renders it dangerous; and it is observed in the Encyclopædia Britannica; "We have seen a pillar of fir twelve inches long and one inch in section, when loaded with three tons, snap in an instant when pressed on one side by sixteen pounds, while another bore four and a half tons without hurt, because it was enclosed (loosely) in a stout pipe of iron." If a piece of timber is placed upright, it would appear at first as if it would carry any weight, but experience teaches that when a post is more than seven or eight times the section of its base in altitude, it bends before crushing; and when a piece of timber is 100 times its diameter, it will not bear the slightest pressure at all in an upright position. The strength therefore diminishes in proportion to its section and height. To crush a post of fir which is too short to bend, 56.16 pounds are required, and for oak 49.72 lbs. for every $\frac{888}{1000}$ area of an inch at the base. The relative proportion of height and strength is however very difficult to determine with accuracy. From the first moment that timber begins to bend it decreases in strength. From many experiments Rondelet deduced a rule, also adopted by M. M. Perronet, Lamblardie, and Girard, which is, we believe, the only one in practice. His observations were on cubes of oak and fir, and he deduced that assuming 44 pounds per square line as the load, which is essential to crush a cube of oak, and 52 lbs. to a cube of deal, the weights necessary to bend and break posts of any determinate square section and which are in length successively 12, 24, 36, 48, 60, and 72 times the side of their

section in height, are respectively $^5/_6$ $^1/_2$ $^1/_3$ $^1/_6$ $^1/_{12}$ and $^1/_{24}$ of the force necessary to *compress* a cubical piece of the column. Rondelet also concluded that a square column of oak or deal *began* to yield by bending when its height was ten times the side of its section. The weight and measures that were used by him, were of the old French system in which one pound weighs 7,561 English grains Troy; and one foot measures 12.78933 English inches. The same authority remarked that cubes of oak and fir diminish in height by *compression* previously to their lateral cohesion being destroyed; the last one half, and the former more than one third. From these experiments we obtain the valuable results that, for a post to be secure, it should never be more than ten times its area at the base in height; and, when thus, the greatest weight that ought to be trusted to it must not be more than 5 lbs. per 1.066 lines; when the height is fifteen times the area of the base, 4 lbs.; and when twenty times, not above 3 lbs. The bases of posts should be extended in accordance with the amount of weight to be carried and their stability carefully attended to; this is in proportion to the base, the diameter or section of which in reference to the height of the column may vary as 7 to 10.—The ancient Greeks had perhaps as correct a perception of the strength of upright columns as any other nation seems capable of attaining. The experiments of our most skilful engineers do not, we be believe, give results that are to be compared with the clear manner in which the Greek architects distinguished the limits of the Doric columns. In all these, from the lowest up to those six times their diameter in height, the fracture is one of *detrusion* along planes whose inclination to the line of pressure are always the same in any given material, evidently depending on the ratio between the repulsive and sliding forces, just as the inclination at which a body will slide on a plane depends on the ratio between its weight and friction. The poets were scientifically correct in calling them "unbending;" for the above takes place with less force than will suffice to produce flexure. We may remark here that Dr. Young differs from the result of the investigations of M. Lagrange, considering it an error to suppose that columns are to be considered as *elastic beams* bent by a longitudinal force. Dr. Young states that, in reality, a stone column is never so slender as to be bent by a force which it can bear without being crushed; and even for such columns as are capable of being bent by a longitudinal force he believes M. Lagrange's determinations to be often inadmissible; but were we to enter fully into all these differences of opinion we should never arrive at the end of our article. Resistance to compression is as great as that power which would tear timber asunder. When the weight begins to overpower cohesion, the centre fibres swell out; and the resistance to such an effect depends of course, on the lateral adhesion of the fibres, which may be compared to a bundle of rods which yield just in the proportion in which they are tied firmly together. Timber with cross-grained fibres offers least resistance, and thus it is (if Muschenbroeck's experiments are to be relied upon) that fir is so much superior to oak as a pillar, for it will carry three times the weight, although oak is far preferable as a tie. We may from this perceive how a very considerable degree of strength may be given in the building up of a beam by making the part stretched of oak and the other portion of fir. We shall close our observations on timbers placed vertically with some remarks from the Encyclopædia Britannica. "When a column is crushed, its resistance to compression seems to depend in a great measure on the force of lateral adhesion, assisted by a kind of internal friction, dependant on the magnitude of the pressure; and it commonly gives way by the separation of a wedge in an oblique direction. If the adhesion were simply proportional to the section, it may be shown that a square column would be most easily crushed when the angle of a wedge is equal to half of a right angle: but if the adhesion is increased by pressure, this angle will be diminished by half the angle of repose appropriate to the substance. The magnitude of the lateral adhesion is measured by twice the height of the wedge, whatever its angle may be. It is obvious that experiments on the strength of a substance in resisting compression ought to be tried on pieces rather longer than cubes, since a cube would not allow of the free separation of a single wedge

sufficiently acute. The same consideration of the oblique direction of the plàne of easiest fracture would induce us to make the outline of a column a little convex externally, as the common practice has been; for a circle cut out of a plank possesses the advantage of resisting equally in every section; and, consequently, of exhibiting the strongest form, when there is no lateral adhesion; and in the case of an additional resistance proportionate to the pressure, the strongest form is afforded by an oval consisting of two circular segments, each containing twice the angle formed by the plane of fracture with the horizon. If we wish to obtain a direct measure of the lateral adhesion we must take care to apply the forces concerned at a distance from each other not greater than one sixth of the depth of the substance, otherwise the fracture will probably be rather the consequence of flexure than of detrusion."

We have now concluded our general observations on Carpentry, which, from the science required properly to apprehend its principles, may truly be termed a liberal art. It would be as well if the principles above briefly enunciated were more attended to by the practical workman, instead of his contenting himself with a few routine rules the *reasons* of which are a total mystery to him. Our observations must not be considered too elaborate for the ordinary workman, as their defect is that, on account of our limits, we are unable to go as deeply into the subject as we could wish. If he studies carefully what is said, he will perceive that the principles laid down are as easy of comprehension as they are absolutely essential to be understood, If he cannot understand them, he will always remain a workman; if, on the contrary, he succeeds in thoroughly mastering the theory, and, above all, applies the information gained to practice he will become something far different from a mere machine carrying out the ideas of other minds.

DESIGN FOR A PAIR OF SECOND RATE HOUSES.

Plates 52. 53.

These houses may be erected either singly or in pairs, but the latter will be decidedly preferable. The accommodation is ample for houses of this class and comprises on the Basement;—

A Kitchen	18′ „ 0″ × 13′ „ 0″
A Scullery	13′ „ 0″ × 13′ „ 0″
A Larder and Dairy	16′ „ 0″ × 12′ „ 6″
Beer, Wine, and Coal Cellars, and W. C.	
On the Ground Floor are,	
A Dining Room	18′ „ 0″ × 16′ „ 0″
A Breakfast Room	18′ „ 0″ × 13′ „ 0″
A Library	13′ „ 0″ × 13′ „ 0″
Lobby Hall and W. C.	
On the Chamber Floor are	
A Drawing Room	26′ „ 0″ × 16′ „ 0″
A Bed Room	18′ „ 0″ × 13′ „ 0″
A Bed Room	13′ „ 0″ × 13′ „ 0″
China Closet, and smaller Closets.	

The principal front and sides are proposed to be cemented on the basements and faced with second malm stocks above, the dressings being of cement; the brackets under the eaves are to be of wood and the roof is to be slated. The cost of construction, the internal fittings and the materials generally being of good quality, will be under £2,000 for the pair.

DESIGNS FOR TWO LODGES OR SMALL COTTAGES.

Plate 54.

This Plate contains two designs which are about equally adapted for lodges at the entrance into the grounds of a mansion, or as cottages for labourers; if appropriated for the latter purpose, the amount of exterior effect will probably be reduced. One of the designs contains two floors, and in the other the accommodation is comprised on one level. The former has on the Ground Floor, a Porch, an Entrance Passage and Staircase with a Closet beneath the latter for tools, etc.

A Living Room	10′ „ 0″ × 10′ „ 0″
A Scullery	10′ „ 0″ × 7′ „ 0″
Larder, Coal and Wood Cellar, both of ample size.	

A covered space corresponds with the Porch on the opposite side, beneath which a seat is placed; and a door at the back leads into the garden or yard.

On the Chamber Floor are

A Front Bed Room	13′ „ 9″ × 10′ „ 3″
A Bed Room for Children leading out of the former	14′ „ 0″ × 5′ „ 4″
A Back Bed Room	10′ „ 10 × 7′ „ 4″

Two closets are provided and fire places to two of the Bed Rooms.

The style which has been adapted in the treatment of the elevation of this cottage is of that late Gothic character usual in the sixteenth century, and which consisted in a combination of wood and brickwork, often plastered all over on the face. It is proposed in this instance to omit the plaster and allow the timber to show, the brickwork being red on the face; the quoins on the lower part may be of any stone which can be procured in the neighbourhood.

We have before made some remarks commendatory of the use of brickwork on the face of walls in preference to cement, and with the object of disabusing the public mind from that idea of commonness which is so absurdly attached to the use of bricks. What, for instance, can be more common than cement, and what more reprehensible than the general object of its use, namely to conceal bad bricks and bad workmanship? We may add to what we previously remarked that the Romans, who are generally allowed to have had some ideas of what is appropriate in art and to be not *inferior* to us in their perception of beauty, used brickwork very extensively in the works they erected in this country; but somehow the art appears to have been lost until the latter part of the 13th century; and Little Wenham Hall in Suffolk, erected about 1260, is the earliest building in England with bricks similar to those now in use. After the time of Richard II., bricks moulded into various forms were often used for the jambs of doors and windows in districts in which stone was not easily to be had, and it was in this reign that we learn from Leland of the first instance of a very large application of brickwork since the days of the Romans. "Michael de la Pole, merchant of Hull, came into such high favour with King Richard II., that he got many privileges for the towne. And in his tyme the towne was wonderfully augmented yn building and was enclosyd with ditches and the waul begun; and in continuation endid, and made all of bricke as most part of the houses at that time was." M. de la Pole, we also find, "builded a goodlie house of bricke against the west end of St. Marye's church, *like a palace,* with goodly orcharde and garden at large, also the houses besides, every one of which hath a tower of bricke." The contrast in the design given between the red brickwork and the wood and stonework, will be found productive of a very pleasing effect; and the varied outlines, the breaks and covered recessess, together with the lofty pitched roof, covered with tiles, the dormer and the soaring chimney shaft, are all features which render this cottage suitable for a spot surrounded by trees and as the entrance gate to the grounds of a mansion in the Old English style.

The expense of its erection will average about £200.

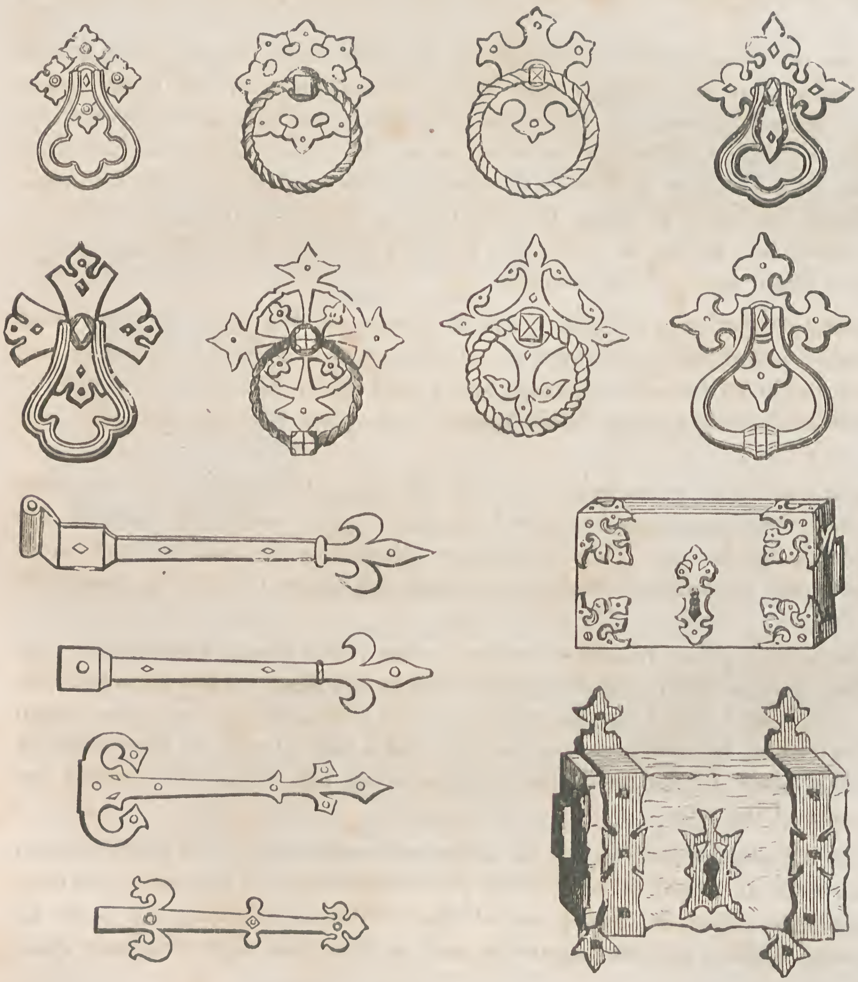
The design below, containing the rooms all on one floor, comprises;—

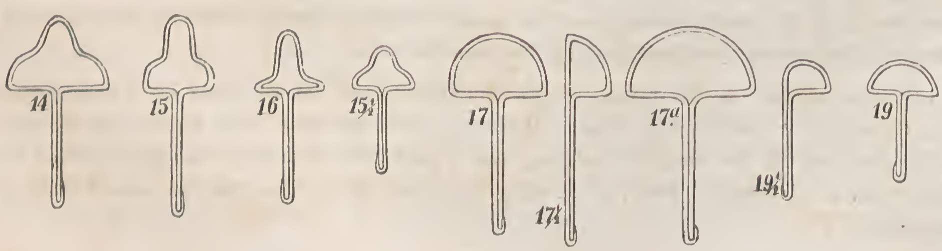
A Living Room	14′ „ 0″ × 12′ „ 0″
A Scullery	8′ „ 0″ × 7′ „ 0″
A Bed Room	10′ „ 0″ × 7′ „ 9″

Entrance Passage, Larder and Cellar for Coals and Wood.

This Cottage, although smaller than the other, is of more pretension and more expensive in the details of its elevation. The style is the late Perpendicular or Tudor, the last developement of Gothic Architecture, which prevailed in England during the fifteenth and early portion of the sixteenth century. A leading characteristic is the square arrangement of the mouldings over the heads of doors and windows, and the manner in which the mullions of the latter are carried up *perpendicularly* instead of being bent aside in geometrical curves as in the earlier phases of Gothic architecture. Transoms, crossing the mullions and dividing the windows in their height, are another peculiar feature of Perpendicular work; bay-windows also were first used in it, and arches with four centres, very much flattened, towards the end of the style are common; and the chimney shafts would appear to have almost exhausted invention in their diapered twisted forms and peculiar heads and bases. The design given illustrates these observations. The large bay-window is an effective external feature, and is, at the same time, a material addition to the living

room and a great convenience so far as commanding views in three directions in case the cottage is appropriated as a lodge. Details of some of the mouldings are given on the plate. The main walls are proposed to be built of limestone laid in narrow courses indiscriminately, that is two or more courses to each quoin, axed or hammer dressed externally and neatly pointed in coal-ash mortar. Turn arches over the back and side openings not less than 12″ in height; each arch to have proper arch joints, well bedded in soft mortar. The quoins are to be of picked stones, neatly tooled, squared and well bonded, the arris kept sharp and accurate. The stones to be jointed as shown in the Principal Elevation and the mouldings executed in accordance with the details. The sills to be in large stones, properly weathered and the joints made thoroughly water-tight. The mullions are to be grooved for the insertion of lead lights, and saddle bars are to be let in for securing them, after which they are to be neatly pointed. Holes are to be drilled for the escape through the sills of the condensed moisture from the glass. The chimney shafts are to be worked with circular funnels. Fir timber is to be used, and the roof is to be slated. The locks and hinges should be in character with the style of the lodge and not of the ordinary description. We annex wood cuts of a few which may be procured ready





manufactured and at a reasonable price from Hart and Son. Instead of lead lights, zinc bars may be used; they will be found durable and very much cheaper than lead lights. The sections below may be procured for $1^1/_2d$ or $2d$ per foot and other sizes so low as $^3/_4d$ per foot; the larger ones for shops being proportionately cheap. The average expense of this design, if executed as above indicated will be £250.

We made in an earlier portion of the work a connected series of observations in describing our Model Cottages on points of importance relating to the erection of dwellings for the labouring classes; we shall set down under the present heading some further remarks on the subject; and we cannot do better than commence with the following observations from Mr. Loudon's writings.

"The Cottage should be placed alongside a public road, as being more cheerful than a solitary situation, and in order that the cottager may enjoy the applause of the public when he has his garden in good order and keeping. Every cottage ought to have the floor elevated that it may be dry, the walls double, or hollow, or battened, or not less than eighteen inches thick, that they may retain heat; with a course of slate or flagstone, or tiles bedded in cement six inches above the surface, to prevent the rising of damp; the roof thick or double for the sake of warmth; and projecting eighteen inches or two feet at the eaves, in order to keep the walls dry, and to check the radiation of heat from their exterior surface.

"Every cottage, including its garden, yard, etc., ought to occupy not less than one sixth of an acre; and the garden ought to surround the cottage, or, at all events, to extend both before and behind. In general there ought to be a front garden and a back yard, the latter being entered from the back kitchen and containing a privy, liquid manure tank, place for dust and ashes, and place for fuel.

"When there is a supply of clear water from a spring adjoining the cottage, or from some other efficient source, then there ought to be a well or tank, partly under the floor of the back kitchen for drawing it up for use. The advantages of having the tank or well under the back kitchen are that it will be secure from frost and that the labour of carrying water will be avoided.

"The privy should always be separate from the dwelling, unless it is a proper water-closet, with a soil pipe communicating with a distant liquid manure tank or cesspool. When detached, the privy should be over or adjoining a liquid manure tank, in which a straight tube from the bottom of the bason ought to terminate; by which means the soil bason may always be kept clean by pouring down the common slops of the house, no surface being left from which smells can arise except that of the area of the pipe.

"The situation of the liquid manure tank should be as far as possible from that of the filtered water tank, or clear water well. It should be covered by an air-tight cover of flagstone, and have a narrow well adjoining, into which the liquid should filter through a grating, so as to be pumped up or taken away without grosser impurities, and in this state applied to soil about growing crops.

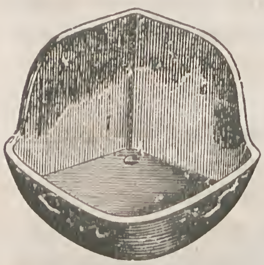
"In general the proprietors ought not to trust the erection of labourers' cottages on their estate to the farmers, at it is chiefly owing to this practice that so many wretched hovels exist in the best cultivated districts of Scotland and in Northumberland.

"No landed proprietor, as we think, ought to charge more for the land on which cottages are built than he would receive for it from a farmer, if let as part of a farm; and no more rent ought to be charged, for the cost of building the cottage and enclosing the garden than the same sum would yield if invested in land, or at all events, not more than can be obtained by government securities."

The above observations merit the attention of all interested in the erection of cottages; they are extracts from a "Report to her Majesty's Principal Secretary of State from the Poor Law Commissioners on an Enquiry into the Sanitary Condition of the Labouring Population of Great Britain." As before remarked they were contributed by Mr. Loudon.

The general causes of unhealthy cottages may be briefly summed up as the open privy or badly trapped W. C., the open cesspool and badly ventilated drains, accumulated uncovered dust, an impure supply of water, deficient ventilation and warmth, and damp rising through the walls.

With respect to drainage, if it is not always possible to do as we please in cities, in the country it is unpardonable to neglect it. Drains should always be laid with an ample fall, be flushed as frequently as possible, in order that whatever may gradually accumulate and block them up and all noxious gases may be carried off. The ventilation of sewers should be secured by causing fresh air to enter them at a low level, and allowing the vitiated air to escape at a high level. Particular care should be devoted to the trapping of soilage drains, and they should be made thoroughly watertight, so that the liquid portion cannot escape and leave the solid matter alone in the drain. Mr. Hosking's proposition of ventilating each house drain by forming a communication from it into a chimney flue is ingenious and would be found very effectual, as the air of the drains is from thirty to fifty per cent lighter than the external atmosphere. The stoneware drains will be found the cheapest and best, and Doulton's sinks, closet basins, and urinals of the same material are adapted for cottage purposes.



The supply of good and pure water is of the highest consequence: the theory of wells should be understood by all, and we extract from Mr. Cresy's Encyclopædia of Civil Engineering a few remarks which will render the matter perfectly clear.

"In most parts of England water is obtained from wells, some of which are Artesian. Of the quantity of rain which descends in our latitude one third has been estimated as passing off by evaporation, the remaining two thirds being required for the support of animal and vegetable life and to supply the subterranean springs. Rain water either runs off upon the surface or percolates the strata, being received into the fissures or vaults of the earth, where it forms subterranean reservoirs.

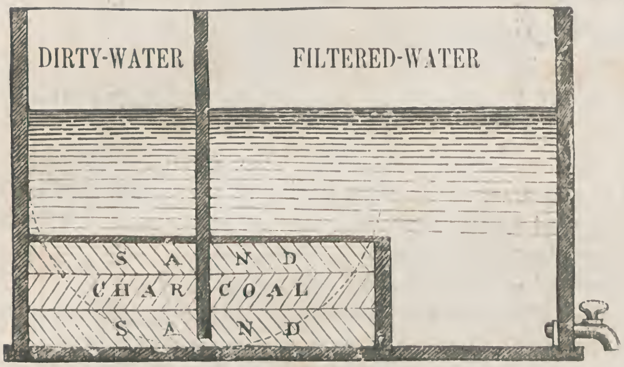
"Where beds of gravel rest upon a substratum of clay, the lower portions contain water; if the clay is thin and has fissures or openings in it, the water passes through and continues to descend till it meets some other layer which will retain it. Some wells are supplied by water descending in the strata, others by its ascent from below by means of hydrostatic pressure, which is the case with Artesian wells or perpetually flowing springs; these are numerous in the neighbourhood of London where they are formed by penetrating the chalk or the plastic clay formation. At Sheerness the sandy strata of the plastic clay formation was reached after boring through the London clay 330 feet, and in many districts the chalk has been pierced to a considerable depth beneath the clay and abundance of water obtained, which is generally perfectly clear and bright, for by its passage through the various strata it is deprived of all that it held mechanically as well as other impurities which are taken up by one earth or the other.

"The district called the London Basin may be considered as a continuous seam of chalk, varying in thickness and sometimes covered with sand and gravel, alternately with plastic clay, over which is a thick stratum of London clay.

"Under the chalk basin is a substratum of clay through which water will not pass and consequently a large supply is always to be found in it. The surface of the water in this subterranean reservoir does not stand at one uniform level but rises in a distance of 14 miles, as between Watford and the highest spring in the chalk hills, as much as 300 feet."

The rain water should be collected from the roofs of cottages and should be carefully preserved as the purest of all water. The average quantity of water which falls in England per year is about 120 gallons to every square yard of surface; so that if a building has a roof surface of 100 square yards 12,000 gallons of water will fall on it during the year.

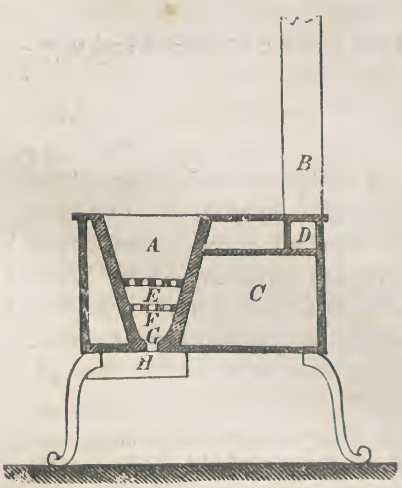
Rain water tanks are sometimes constructed with filters attached to them. We think, however, that most cottagers would prefer a filter in the house and we do not believe in the invariable efficacy of the subterranean combination of tank and filter. Portable filters are cheap and absolutely requisite articles, and, of late years, that clean and beautiful material slate has been extensively employed for them.

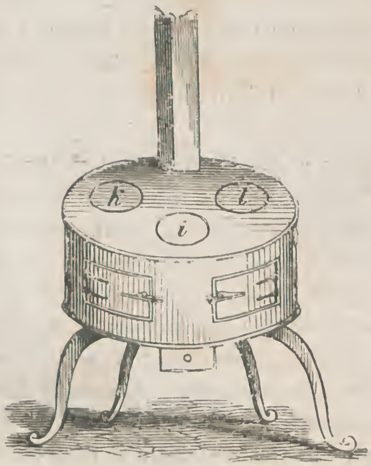


We annex a section of a very convenient and efficacious filter manufactured by Messrs. Braby and Son, Bangor wharf, Lambeth. The dotted line indicates the course of the water, which passes through successive layers of coarse sand, charcoal, and fine sand, covered over with a thin piece of slate, pierced with small holes. The ordinary filters with filter stones are objectionable, being very liable to become soon blocked up, the stone being impregnated with matter and then quite useless.

A sufficient and equable temperature and economy of fuel are very important matters for consideration, and we shall add here a few remarks to those formerly made on cottage stoves.

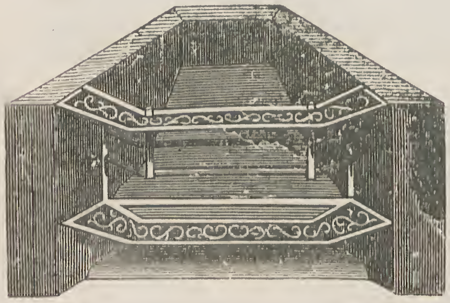
One of the most economical cottage stoves is that in use in the cottages about Bruges in Belgium and is illustrated in the margin.



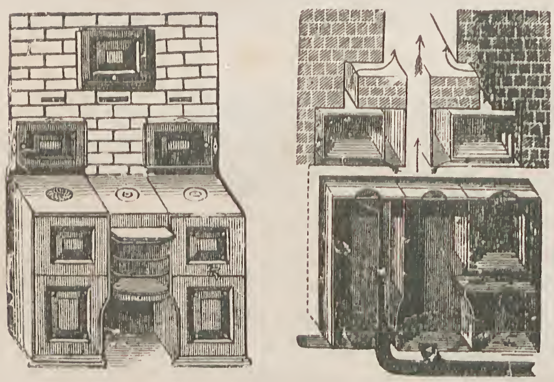


It contains two ovens, and thus a loaf may be baking in one and meat in another, while at the same time boiling and stewing may be going on at the top. The stove will also consume an inferior description of fuel and will produce an intense heat from what will scarcely burn in an ordinary fireplace. *A*, is the fireplace closed at the top by the lid *i*; *B*, is the flue; *C*, is the oven; *D*, is a square opening admitting the smoke into the flue, the flame passing along the channel to it and heating the oven and the top of the stove; *E*, is a grating removable at pleasure to increase the size of the fire, and *F*, is a smaller grating for the same object; *G*, is a fixed grating, and *H*, is a box for cinders which draws out for the purpose of removing them; *k* and *l* are lids opening into the smoke flue. These stoves are thus very complete, and may either stand out in the room, in which case of course more heat is radiated, or be placed in the usual recess. We believe they may be procured ready manufactured in London, but are unable to state where.

In the article on the Model Cottages we alluded to Savot's method of heating two rooms by means of one fire. We now place before the reader a diagram of a cottager's grate (patented by Mr. Pierce of Jermyn Street) for the same purpose. It may be transferred to any room having a fireplace, as it requires no fixing. It is used in the Model Cottages erected by Prince Albert and now in Kennington Park. These grates are made of the best fireclay, having the back part hollow to form an air chamber for the admission of fresh air, introduced from the outside by means of earthen pipes; this fresh air passing through the back of the grate becomes warmed, and will thus supply a bed room over the living room, or a room adjoining, with a large quantity of pure warm air without an additional fire. The economy consists in requiring but a very small quantity of fuel and giving sufficient warmth for another room in addition to the radiant heat produced by the fire. The stove has also the additional advantage of a table bar at the bottom and a large trivet at the top.



The last stove we shall mention as adapted to cottages is one suggested by Mr. William Griffin in the Practical Mechanic's Journal. The diagram represents an elevation and section. The stove is fitted with an oven and hot closet, an open fireplace with a draw shelf at the bottom of the grate, a drop shelf at the top which, when raised, forms a blower, a hot plate forming an ironing stove, an opening at the top for the emission of warm air, a boiler and a damper and sweep door. In the flange of the oven and hot closet, are slide doors for the purpose of admitting a brush when sweeping is necessary. As the oven is principally heated by hot air, or carried heat, while it has a flue all round it, it heats on all sides alike, and without scorching or burning, and the heat being confined by dampers it requires less fuel for cooking than the ordinary ranges. When the cooking is over a fire made up of small coal, cinders and ashes, well saturated with water, will last several hours. The room is kept agreeably warm by means of a supply of pure warm air drawn in from without through a drain or pipe to the hot air chambers at the back and side of the fireplace and emitted at the top of the stove.



We have not many observations to add on the subject of damp. We have before spoken of damp courses and their necessity as well as the desirability of concrete and the efficacy of a continuous arched space running round a house for the purpose of preventing the earth resting against the walls. Hollow bricks have been much praised as a remedy; their general advantages are thus stated by Mr. Chadwick who considers them superior to common brick and stone;—

In preventing the passage of humidity and being drier.

In preventing the passage of heat, and being warmer in winter and cooler in summer.

In being a security against fire.

In preventing the passage of sound.

In having less unnecessary material and being lighter.

In being better dried, and burnt harder and stronger.

In being more cleanly.

In being cheaper.

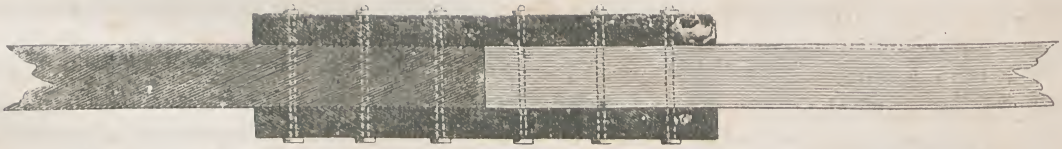
We can but add that if one half of this formidable list of advantages really appertains to them we heartily recommend their more universal introduction.

We conclude our observations on Cottages and their fittings by stating a mode of preventing damp suggested by a correspondent of the Gardener's Chronicle. "I have just constructed a garden wall of stone on which I intend to stretch a wire trellis, like the invisible wire fence, to save defacing the walls, and to prevent the fruit being eaten up by wood-lice, etc. I have cut off the capillary attraction of the wall by boiling gas-tar and lime together and spreading it on the stone about 6 inches from the earth. This has answered the purpose, wears very well, the stone beneath the tar being dark and wet, all above being white and perfectly dry—the whole expense of a wall for half an acre of garden being only a few shillings. The compostion must be laid on boiling and afterwards more lime sprinkled over to dry it. This would do for any wall and the expense not to be compared with slate and cement."

THE PRACTICE OF CARPENTRY.

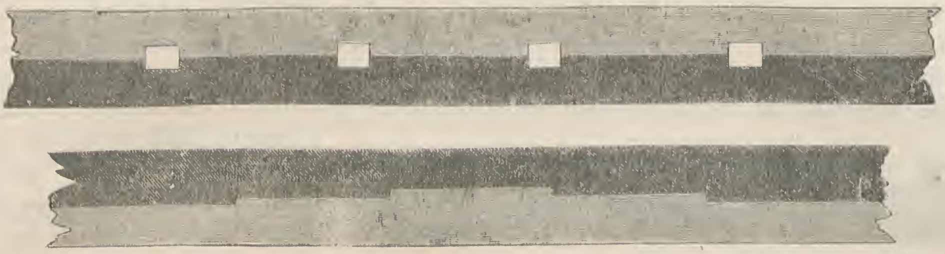
Having considered the theory or mechanical principles of Carpentry, we will next proceed to treat on that part of the practice relating to the various methods of joining timber. These are divided under three headings; first, joints for lengthening timber; second, mortice and tenon joints; third, the various methods of notching, lapping, halving, etc.

First then joints for lengthening timber. Scarfing is a very general mode of increasing the length of beams for wide roofs, floors, etc. The perfection of a scarf is in proportion as the strength of the two pieces of timber joined approaches to that of a single piece. Many very peculiar methods are practised as great nostrums by various carpenters; but, when we consider the mode in which the cohesion of the fibres acts, it will be clear, that the simplest are as effectual as the most complicated, and that with them there is less likelihood that we shall be led into false ideas of the strength of combination. The strongest of all methods is one which is not, strictly speaking, a scarf, for in a scarf the two pieces of timber should appear as one; it consists

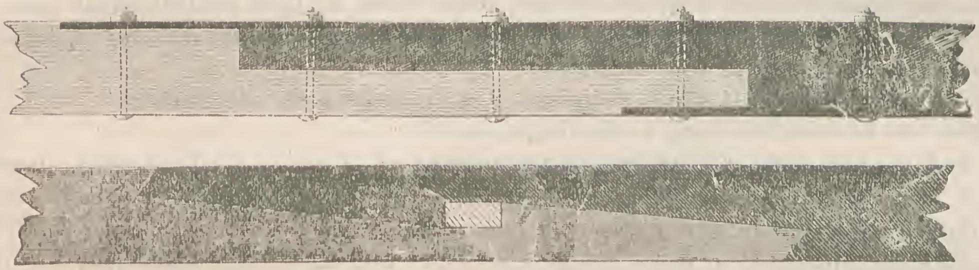


in setting the beams end to end as in the engraving, and grasping them firmly by means of pieces on both sides bolted together. This is called *fishing* a beam, and is much practised by ship carpenters. It is objected to on account of its clumsy and unscientific appearance. We should not however be guided by mere attempts to please the eye, where strength is an object, and in designing scarfs, particular attention must be paid to the changes which the shrinkage of the timber produces, and how the framing may be so disposed, that the particular tendencies to shrink shall be in the same direction with the shrinkage of the whole; if this is not attended to,

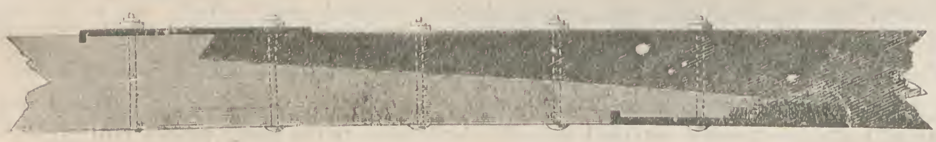
the parts will be split asunder and the seams widen. The two diagrams illustrate a mode of building up a beam for a girder by joggling and scarfing. The lowermost will be preferred by



many, as they will argue that the upper piece grasps the lower, but the joggled beam is easier executed and will be found the strongest. Figs. 4. and 5. Plate 2. represent two of the simplest forms of scarfing, consisting of lapping or halving, sometimes called ship-lapping; equal quantities of each piece are cut away, and the pieces are then united by bolts: this method is often applied to plates and bond timber. For girders and posts the cutting, Fig. 4. on Plate 3., is applicable. The key in the margin is not absolutely essential and the two pieces might meet; but



the key has its use in forcing the parts together with great tightness; it must not, however, be too large or be over-driven, and thus produce a strain on the internal parts. Keys should be of some hard wood having a curled grain, which resists the insertion of the fibres opposed to it. The uppermost diagram above has but one half the strength of an entire piece, and Fig. 4. Plate 3. and the adjoining scarf in the margin have probably not above a third; but if iron plates are placed



at the top and bottom, the bolts are prevented bending by the violent strain, and the strength of the combination is greatly increased. Figs. 6. 7. 8. 9. Plate 2. are all good forms of scarfing; fig. 10. is rather complicated, being what the French call "*traits de Jupiter*" from its fancied resemblance to a flash of lightning. Bolts may be often dispensed with, but they decidedly always add greatly to the strength of a scarf. Fig. 11. Plate 2. is an excellent scarf adapted for carrying a great weight, and illustrating the use of bolts and straps. If a transverse and downward strain is to be resisted, it will be an improvement to terminate the upper and right hand end of the scarf by a plain butt end of half the depth of the timber, omit the indents on each side of the centre, and apply a key, or folding wedges to the middle indent, making a half dove-tail to the lower and left hand end of the scarf. The reason of this will be obvious if the reader recalls

what is stated in the article on the Mechanical Principles of Carpentry, where it appears that in transverse strains on beams, the upper surface is compressed and the lower extended, as shown in the diagram. The strap or stirrup irons hold the timbers in their places, and the bolts prevent their being draw asunder. Fig. 12. is a common and good form, and Fig. 13. completes the illustrations there given. Acute angles in scarfs, we should mention, have been objected to on the ground that they cause the two pieces to tear each other up, and, as a general rule, the abutments should be perpendicular to the direction of the pressure. The scarf in the margin is bad, for it

begins to yield where the wood is splintered or crippled and easily tears up. We will close our remarks on scarfing with the following useful summary of practice from Tredgold's Carpentry, edited by Barlow.

"The length of the scarf should be, if bolts are not used; —

In oak, ash or elm, six times the depth of the beam.

In fir, twelve times the depth of the beam.

If bolts and indents are combined, the length of the scarf should be; —

In oak, ash, or elm, twice the depth of the beam.

In fir, four times the depth.

In scarfing beams to resist transverse strains, straps driven on tight are better than bolts.

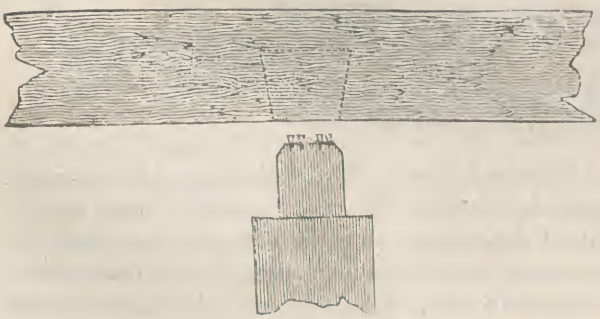
The sum of the areas of the bolts should not be less than one fifth the area of the beams, when a longitudinal strain is to be borne.

No joint should be used in which shrinkage or expansion can tear the timbers.

No joint can be made so strong as the timber itself."

We shall not here make any remarks on the building up of masts, a subject which appertains more to ship-building and which is somewhat foreign to the character of our observations, it being probable that few of our readers will require to know much about it. Fig. 25. Plate 2. shows what will perhaps be more useful, a mode of forming a longitudinal joint in upright timbers where a vertical pressure only is to be borne. It is a species of vertical scarfing on the principle of mortise and tenon. The joints are kept short, as the main object is to preserve the two pieces in the same line.

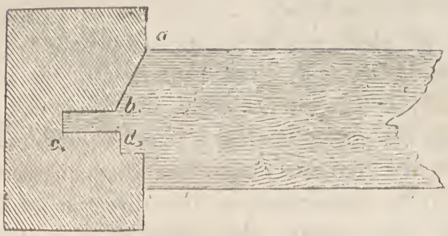
Mortise and Tenon. A Mortise is defined by Gwilt as, "in carpentry and joinery a recessed cutting within the surface of a piece of timber to receive a projecting piece, called a tenon, left on the end of another piece of timber, in order to fix the two together at a given angle. The sides of the mortise are generally four planes at right angles to each other, and to the surface whence the exacvation is made." Figs. 14. 15. 16. 17. Plate 2. are various forms. Fig. 24. is called a *sub-tenon* and is used at the feet of uprights in partitions, etc.; it is very short, and tenons are generally made one-third the thickness of the timber they are cut from. King and Queen posts of roofs are usually tenoned into the tie-beams; if the piece passes entirely through



the latter, a sawcut may be previously made at the bottom, and a piece of wood afterwards driven into this, so as to wedge it in; a strap or bolt is, however, more secure. *Wedging* may generally be defined as consisting in the insertion of triangular pieces into, or by the end of a tenon, to fill up the mortise more completely. That which is called *fox tail wedging* is illustrated in the margin; small wedges of hard wood are

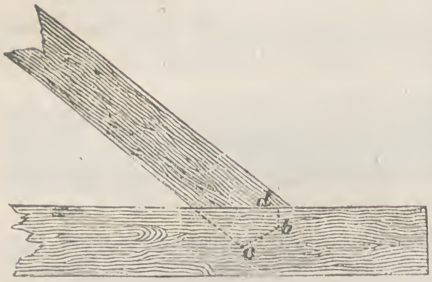
let in, which, of course, as the tenon is pushed to its place, are driven in and cause the lower part of it to expand, so as to fit into the sloping mortise, which should be enlarged in proportion as this is to take place.

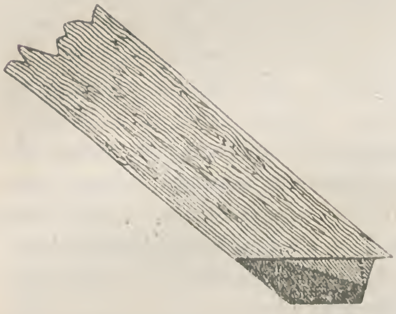
The wood girders of floors frequently require to be mortised, in order to receive the binding joists. The form in the margin is excellently adapted for this purpose. The mortise in the girder should be as near as possible to the upper side, for the simple reason that the girder becomes concave on that side from the strain; but, as the tenon of the binding joist is thus exposed to the risk of being torn off, it is necessary to mortise a little down. The sloping part *a. b.* gives a very firm support in addition to the bearing *c. d.*; and great care should be taken that the tenon fit the mortise very accurately.

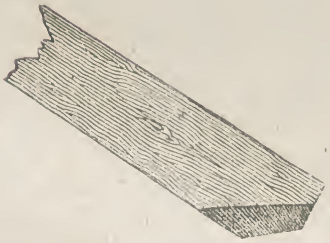


When tenons have to resist a strain, tending to draw them from their mortises, as well as a lateral displacement, they must be always pinned or wedged. An oak *treenail* or pin, or sometimes an iron bolt, is driven through the sides of the mortise; or the tenon may extend through the mortise, and have a cross pin through the projecting part. This is often done in connecting trimmers and bridging joists to the main joists and binders in flooring.

Fig. 26, Plate 2. are two forms of an *oblique mortise and tenon.* Professor Robinson remarked; — "The joint that most of all demands the careful attention of the artist is that which connects the ends of beams, one of which pushes the other, very obliquely, putting it into a state of extension. The most familiar instance of this is the foot of a rafter, pressing on the tie-beam, and thereby *drawing* it away from the other wall. When the direction is very oblique (in which case the extending strain is the greatest) it is difficult to give the foot of the rafter such a hold of the tie-beam as to bring many of its fibres into proper action. There would be little difficulty if we could allow the end of the tie-beam to project a small distance beyond the foot of the rafter; but indeed the dimensions which are given to tie-beams for other reasons, are always sufficient to give enough of abutment when judiciously employed. Unfortunately this joint is much exposed to failure by the effects of the weather. It is much exposed and frequently perishes by rot, or becomes so soft and friable, that a very small force is sufficient either for pulling the filaments out of the tie-beam, or crushing them altogether. We are therefore obliged to secure it with particular attention, and to avail ourselves of every circumstance of construction. One is naturally disposed to give the rafter a deep hold by a long tenon; but it has been frequently observed in old roofs that such tenons break off. Frequently they are observed to tear up the wood that is above them, and push their way through the end of the tie-beam. This, in all probability, arises from the first sagging of the roof, by the compression of the rafters and of the head of the king-post. The head of the rafter descends, the angle of the tie-beam is diminished by the rafter revolving round its step in the tie-beam. By this motion the heel or inner angle of the rafter becomes a fulcrum to a very long and powerful lever much loaded. The tenon in the other arm is very short, and being still fresh, it is therefore very powerful. It therefore forces up the wood that is above it, tearing it out from between the cheeks of the mortise, and then pushes it along. Carpenters have therefore given up long tenons, and give to the toe of the tenon a shape which abuts firmly in the direction of the thrust on the solid bottom of the mortise, which is well supported on the other side by the wall-plate. This form has the further advantage of having no tendency to tear up the end of the mortise." The form is represented on the next page. The tenon has a small portion *d. b.* cut perpendicular to the rafter. The next woodcut is the joint recommended by Price, and copied in most books as the *true joint*; but the following one is, in our







opinion, preferable, and is in very constant use. Whatever be the form of joint adopted, the great point for attention is that all parts should bear alike, and iron straps or bolts ought to be invariably used whenever the strain is very great; they should be well painted, and bolted with square bolts, for round ones are very apt to follow the angur and do not hold so firmly. As the use of straps is very important, we shall conclude our observations on mortise and tenon joists with some remarks by the distinguished authority before cited "When it is necessary to employ iron straps for strengthening a joint, considerable attention is necessary that we may place them properly. The first thing to be determined is the direction of the strain. We must then resolve this strain into a strain parallel to each piece, and another perpendicular to it. Then, the strap which is to be made fast to any of the pieces, must be so fixed that it shall resist in the direction parallel to the piece. Frequently this cannot be done; but we must come as near to it as we can. In such cases, we must suppose that the assemblage yields a little to the pressures which act on it. We must examine what change of shape a small yielding will produce. The strap that we observe most generally ill-placed, is that which connects the foot of the rafter with the beam. It only binds down the rafter, but does not act against its horizontal thrust. It should be placed farther back on the beam, with a bolt through it, which will allow it to turn round. It should embrace the rafter almost horizontally near the foot, and should be notched square with the back of the rafter. We are of opinion that straps which have eye-bolts in the very angles, and allow free motion round them are of all the most perfect. A branched strap, such as may at once bind the king-post and the two braces which butt on its foot, will be more serviceable if it have a joint. When a roof warps, these braced straps frequently break the tenons, by affording a fulcrum in one of their bolts. An attentive and judicious artist will consider how the beams will act on such occasions, and will avoid giving rise to these strains by levers.

"A skilful carpenter never employs many straps, considering them as auxiliaries foreign to his art, and subject to imperfections in workmanship which he cannot discern or amend."

We next come to the various methods of *notching*, *lapping*, *halving*, *etc.* *Notching* is both square and dovetailed, and is used for connecting the end of wall plates and bond timbers at angles, letting down joists on binders, plates, etc., rafters, or principals, and so on. Dovetailed joints require to be executed with great care on account of the shrinkage of the wood, which takes place more across the grain than in the direction of the length, and *halving* is generally a preferable operation. This term explains itself, and it is usually adopted when the pieces cross at right angles. *Lapping* is either halving the end of each piece, or halving and dovetailing, and in the latter, it will be perceived, the timbers act as a tie, and cannot be easily pulled apart. Bond and wall plates are usually *scarfed* by cutting about $^3/_5$ through each piece, on the upper face of the one, and the under face of the other, about 6 or 8 inches from the end transversely, making what is called a *kerf:* and longitudinally from the end from $^2/_5$ down on the same side

so that the pieces lap together like a half dovetail. *Cogging* or *cocking* is defined by Nicholson as "a method of securing beams to wall-plates by notching each beam at the end on the under edge, across its thickness, nearly opposite to the inner edge of the wall plate, and cutting two reverse notches out of the top of the wall plate, leaving the part whole which is opposite to the notch in the beam; then, laying the beam to its place, it will slide down, and the corresponding parts will fit into each other. This method prevents any possibility of the beam drawing longitudinally out of the wall plate, even though the timbers should afterwards shrink."

On *wedging and pinning* we have before remarked; the latter consists simply in the insertion of cylindrical pieces of hard wood through a tenon. Most of the above methods of joining timber are illustrated on Plate 2. and require no further explanation.

DESIGN FOR A FAMILY RESIDENCE.

PLATES 55. 56. 57. 58.

This is a design for a detached residence suitable for a family. It is proposed to be erected of bricks, with cement dressings for the fronts; the roof is to be slated. The accommodation consists on the Basement Floor of a

Kitchen	20′ „ 0″ × 15′ „ 0″
Scullery	15′ „ 0″ × 13′ „ 0″
Servant's Hall	15′ „ 0″ × 15′ „ 0″
Butler's Room	15′ „ 0″ × 10′ „ 0″
Larder and Pantry	15′ „ 0″ × 12′ „ 0″
Store Room	10′ „ 0″ × 9′ „ 0″
Coal, Wood, and Wine Cellars, W. C. and Vault.	
On the Ground Floor are, —	
Drawing and Dining Rooms, each	13′ „ 0″ × 15′ „ 0″
Library and Breakfast Rooms, each	15′ „ 0″ × 15′ „ 0″
Lobby, Hall, and W. C.	
The First Floor contains, —	
Five Bed Rooms	15′ „ 0″ × 15′ „ 0″
Bed Room with Linen Closet . .	15′ „ 0″ × 10′ „ 6″
Bath Room	11′ „ 0″ × 10′ „ 0″

Two small Rooms are provided in the roof.

The Front Elevation, a Section, and Plan of finished Roof are given, together with a plate of Details, containing a plan of the Flooring joists, a Trussed Partition and an illustration (Figs. 3. 4. 5.) of a method of forming a tie or other beam with small sawn scantlings, if a piece of timber sufficiently large is not easily procurable. The average expense of erection will be about £ 2,600.

BRIDGE ON THE MOHAWK RIVER NEAR ROME U. S.

Plates 59. 60.

We are indebted for these two Plates to the kindness of Mr. Weale, the eminent architectural and engineering publisher, who has permitted us to reproduce them from his valuable work on Bridges. They are illustrations of a timber bridge of 100 feet span. It is a somewhat complicated structure, altogether of great strength, in fact rather in excess than otherwise. The scantlings of the timbers are figured. The framing is somewhat on the principle of a queen-post roof; the great feature is the arch, which is strengthened and steadied by an abundance of posts and struts.

It will be perceived that the framing may be easily adapted to other purposes besides that of a bridge, and this circumstance will add to the value of the engravings to our readers. Plate 59. contains a Front Elevation of the Bridge, with details of the Coping Plank. Plate 60. shows the Isometrical Projection, together with the Section and Plan.

Timber bridges are of great antiquity, and are very general in many districts where the material abounds. They are of course less durable than those of brick or stone, but may, if properly protected, be made to last a long time. Timber for bridges must be considered somewhat differently from that used in the erection of houses, on account of the peculiar vibration from the transit of foot passengers and carriages, which causes it to bend, and its elasticity, or power of returning to its original form, of course gradually decreases. On account of their constant exposure to the alternations of dryness and moisture, and the variable loads to which they are subjected, timber bridges should always be constructed stronger than may be considered as absolutely necessary to enable them to withstand a given pressure; for a certain diminution of strength may be certainly set down for every year in which they are in use. We stated, in the article on the Mechanical Principles of Carpentry, sufficient to enable the reader to comprehend those principles of framing timber which regulate as much the erection of bridges as other timber structures. One of the first considerations in framing them is the manner in which repairs may be easily and rapidly effected, without disturbing the traffic. With respect to the width of road and foot ways, Smeaton said; — "it is found by experience that 18 feet clear width admits of carriages passing with ease, freedom, and safety." Tredgold remarked, — "in my opinion 9 feet is the proper width for a carriage, and 2 feet for a foot passenger; hence the carriage way should be 9. 18. 27. 36., etc., and each footway 2. 4. 6. 8., etc., in width; where the increase is not made in this manner the advantage of it will be very trifling,"

The floors of wood bridges were formerly formed of a pavement laid on a bed of sand, but the great weight and damp necessarily produced renders a false floor preferable, for it protects the framework, and can be renewed at pleasure. Lead and Copper have been suggested as a covering to the planks of the roadway, and we believe that the duration promoted will be found to compensate for the extra expense.

DESIGN FOR A COTTAGE.

PLATE 61.

This ornamental Cottage is approached through the side Porch, 6 feet by 5 feet, which is raised three steps above the surface level, and is open on three sides. The entrance door opens into a Hall 14′ × 8′, communicating, on the left hand, with a Parlour 17′ × 14′, having a bay-window on the side opposite the door, which forms a prominent and ornamental feature in the front elevation. On the right hand is a Kitchen 11′ × 8′, communicating with a Scullery 11′ by 5′. 9″; from which a door, opposite to the kitchen door, opens into a passage with a back entrance on the right hand side, a larder 6′ × 4′. 6″, opposite a water closet 7′ × 3′ 9″, and a China pantry 6′ × 4′. 9″, both on the left hand. The flooring of the Larder, Water Closet, China pantry and passage is placed 7 inches lower than the rest of the rooms on the ground floor. The height of the ceilings of the Parlour, Kitchen, Scullery, and Hall is 9′. 6″ in the clear; that of the Larder, Water Closet, China pantry, and passage 8′ 0.

On the second quarter space is a door communicating with a bed room 12′ × 10′.

Opposite the stairs on the upper landing is a Bath room 8′ by 5′; on the right hand is a bed room 14′ × 14′, and on the left hand is another bed room 14′ × 11′. All these are partly constructed in the roof.

Porch	6′ feet by	5′	feet and 8 feet high.
Hall	14′ „ ×	8′	„ „ 9 „ 6″ high.
Parlour	17′ „ ×	14′	„ „ „
Kitchen	11′ „ ×	8′	„ „ „
Scullery	11′ „ ×	5′ „ 9″	„ „ „
Larder	6′ „ ×	4′ „ 6″	„ „ 8 feet high.
Passage	7′ „ ×	3′ „ 6″ 6′ „	part 8 feet high.
Water Closet	7′ ×	3′ „ 9″	and 8 feet high.
China Pantry	6′ ×	4′ „ 9″	„
Stairs and Upper Landing	9′ ×	8′	9 feet high at the centre.
Bath Room	8′ ×	5′	„
Front Bed room	14′ ×	14′	„
Back ditto	14′ ×	11′	„
Side ditto	12′ ×	10′	„

The construction of this Cottage may be carried out for about £ 270.

THE GENERAL CONDITIONS ATTACHED TO SPECIFICATIONS.

The importance of a clearly defined body of General Conditions attached to Specifications is such, that this Work would not be complete did we omit to lay them before our readers. A Specification, however full, and however accurately the several works may be defined, would often be next to useless without those general provisions, which provide alike for any short-comings, as well as settle the manner in which the works are to be executed, define the time to

be occupied in their completion, provide for any disputes and contingencies which may arise, alterations, additions, and deductions which may be deemed advisable previous to the completion of the contract, secure alike the interests of the employer and the employed, explain many things unstated in the Specification, and settle the mode in which the payments are to be made. The following is a very complete body of General Conditions which may be, either wholly or in part, attached to the Specifications.

THE GENERAL CONDITIONS OF THE CONTRACT.

The whole of the Works described in this Specification and shown on the several Drawings, numbered from 1 to 10 inclusive, with the explanations thereon, are to be executed in the soundest, most substantial, and workmanlike manner, and the whole of the materials are to be the best in quality of their respective kinds, well seasoned, sound, and in every respect complete and perfect. The Contractor is to erect all necessary enclosures, shoring, strutting, planking, etc., and to provide all scaffolding, hoisting, tackle, ropes, ladders, wheeling, planks, together with all required carriage and labour, and whatever else may be needful for the due and efficient performance of the works.

Figured dimensions are to be followed where given in preference to the sizes indicated on the drawings by the scale; and smaller drawings are to be set on one side in favour of the large details provided.

The Clerk of the Works is to be considered as the representative of the Architect, and all his directions are, in the absence of the Architect, to be followed, and he is to have full power to decide on the quality of the materials, the mode of workmanship, etc.

The Contractor is to provide a competent Foreman to each trade.

The Architect is to be at full liberty to require the dismissal from the premises of any man or men for incompetency or misconduct, and the Contractor is not to replace him or them without the full approbation and entire concurrence of the Architect.

In case any unfit material, or materials not the best of their respective kinds, or not corresponding with the Drawings and Specification, shall at any time be brought to the intended works, and used in them, it shall be lawful for the Architect to require the Contractor to remove at his own expense such improper materials from the Premises, and to proceed with the intended Works with sound, proper, and well seasoned materials to the satisfaction of the Architect.

The whole of the bricks, lime, cement, stone, timber, slate, lead, iron, and other materials specified, are to be delivered on the premises, and examined by the Architect, or the Clerk of the Works, previous to their being worked and used in the new erection.

In the event of any portion of the Works not being executed, in regard to Workmanship, according to the Specification and Drawings, but being of inferior quality, and if flaws in the joints, cracks in the panels, shrinkings of timber, or other defects occur, or if any portion is executed contrary to the instructions of the Architect or his representative, it shall be lawful for the Architect to require the Contractor, to remove, take down or demolish such portion of the said work so objected to, and re-instate, and completely make good the same in a sound, substantial and workmanlike manner. And, if after 48 hours notice to the Contractor or his Foreman of the Works, such improper workmanship, or unsound, or unseasoned materials shall not be removed, it shall be lawful for the architect to cause the same to be demolished, or removed to such place as he may think fit, and replaced or re-executed by such workmen as he may appoint, without any liability on his part, or on the part of his employer, for any loss or damage that may take place to the said materials or workmanship objected to, or that may happen to the works in substituting other materials. And the Contractor shall pay all the costs, damages, and expenses thus incurred and attendant on the alterations, or the sum

shall be deducted as liquidated damages from the amount due to the Contractor on the completion of the Works.

The Contractor is to supply tarpaulings, straw, and other temporary coverings to protect the Workmen and the Works on account of the weather or any other cause, as nothing will be allowed to impede or stop their progress; but should the Architect deem it needful at any time to suspend the Works or any part of them, on account of the weather or any other cause, he shall be at full liberty to do so, and no extra charge shall be made on this account by the Contractor. From the commencement of the works to the final completion of the same, the Contractor will be held responsible for any of the materials which may be lost or stolen, or for any damage or defects that may arise, from accident or otherwise (damage from fire excepted), and which losses, damages, and defects he will have to make good and reinstate at his own expense. And this applies not only to the Works intended and shown in the Drawings and described in the Specification, but also to the Premises adjoining the public Footpaths and Carriage way, as also to the Public Sewers, Drains, and Gas Mains, all which damages, whether arising from accident, carelessness, or otherwise, must be thoroughly repaired and made good and perfect to the satisfaction of the Architect.

The Contractor is not to suffer any portion whatever of the Works to be underlet or let at task work, but all the labour is to be by his own Workmen who are paid by him.

The Contractor will have to covenant to prepare during the progress of the carcase all the Joiner's, Mason's and other Works necessary to the completion and finishing of the Erection; as immediately after the roofs are covered in and completed, the eaves, gutters, and drain pipes fixed, and the drains and cesspools executed, the finishings are to be proceeded with on the premises, but not before the aforesaid works are all complete and perfect.

The Contractor is to insure the building for half the amount of the Contract before the first Instalment is paid, and for the full amount of the Contract before the second Instalment is paid, and he is to continue the said Insurance up to the entire period of the Contract; the said Insurance is to be in the joint names of himself and (*name employer*), the receipt for which is to be produced when required. Notices are to be given by the Contractor to all Public Authorities or other persons; so far as the same may be required by the nature of the Works, or to petition or make application to them, as may be necessary, as to any disturbance or damage to the foot or carriage ways, or for leave to cross the public roadway to connect drains, or for any purpose whatever; and the Contractor is to pay all fees, whether those of the District Surveyor or other Parties.

The Drawings are to be equally binding with the Specification, and should anything appear to be omitted in either which is usually considered necessary for the completion of the Works, the Contractor is to execute the same as much as if it had been particularly set forth and shown on both Specification and Drawings; and the Contractor is to make no extra-charge, or derive any advantage from such omissions, but shall supply whatever may be wanting to complete the whole of the works as if fully described, and they are to be left in a perfect state, in accordance with the true and implied intent and meaning of the Drawings and Specification, and the directions for their correct performance as given from time to time by the Architect or his representative. If the Architect shall determine to make any addition or omission or to deviate in any respect from the Drawings and Specification, such addition, omission, or deviation which may be made during the progress of the Works shall not vitiate or make void the Contract, but shall be performed by the Contractor, and the value of the same, whether an addition or deduction, shall be ascertained by admeasurement, and either added or deducted from the amount of the Contract, as the case may be, according to the Schedule of Prices at which the work was undertaken; the award of the Architect in all such cases to be final and binding. And the Contractor is hereby cautioned, in order that disputes may be

avoided and for his own security, that he will not be considered as having any authority for such additions, omissions or deviations and any consequent demand, unless he can produce an order in writing signed by the Architect countenancing such alterations. The Contractor will have to enter into a reciprocal covenant with (*name employer*) for the due performance of their respective engagements, to pay or allow at the option of the other the sum of £ — — as the fixed stipulated and measured damages and compensation agreed to be paid as a *debt* and to be recoverable and allowed as such, without any relief either at Law or in Equity against Payment; such however is not to be enforced against the Contractor unless it be certified by the Architect that the Works, notwithstanding any impediment that might arise, could have been performed and completed had reasonable exertion been used by the Contractor, his agents and workmen.

The Building will be considered as commenced on the third day from the signing of the Contract, and the whole of the Works are to be completed, with the exception of the painting and papering on or before — —, and these latter works finished and the whole building completed and left fit for habitation on or before — —

The Money on account of the Works to be performed is to be paid as follows on the Certificate of the Architect; —

One Fifth when the joists of the One Pair Floor are laid.

One Fifth when the Gutters are laid and the Roof covered in.

One Fifth when the First Coat of Plastering is finished.

The Balance when the Works are certified by the Architect as in every respect complete and perfect.

In the event of differences and disputes arising during the progress of the Works or at their completion, such differences and disputes shall be referred to Arbitrators, one to be chosen by each of the Contracting Parties, with full power to the said Arbitrators to nominate a third, and the decision of any two of the said Arbitrators is to be final and binding upon all parties.

The Works are to be executed under the superintendance and to the entire satisfaction of — (*The Architect will here be named, or if the employer superintends the operations of the Builder, his name will be substituted throughout for that of the Architect.*

DESIGN FOR A PAIR OF ORNAMENTAL VILLAS.

Plates 62. 63.

This is a design for two semi-detached Villas, which may, however, with a little modification be erected continuously. The style of the front is of a Gothic character, but the Houses may, of course, be erected either perfectly plain, or the decorations treated in another manner; and this observation naturally applies to the whole of the other plans given in the course of the work; the ornamentation on the elevations allowing of either total or partial omission or modification. The design under description may be erected of either brick or stone, or of brick with cement dressings; ornamental Gothic chimney shafts may be procured manufactured of various sizes and designs. The roofs are shown slated, with cresting along the top, and parapets rising above the gutters. The fittings may be as described in former Specifications.

The accomodation comprises, on the Ground Plan: —

A Dining Room	15′ „ 0″ × 15′ „ 6″
A Drawing Room	18′ „ 0″ × 13′ „ 6″
A Library	14′ „ 0″ × 12′ „ 0″
A Kitchen	12′ „ 0″ × 12′ „ 0′
A Scullery	10′ „ 0″ × 10′ „ 0″

Hall, Passage, W. C., Wine and Coal Cellars, Store Closet, Pantry and Receptacle for Ashes.

On the Bed Room Floor: —

Bed Room	18′ „ 0″ × 13′ „ ″
do.	15′ „ 6″ × 15′ „ 0″
do.	14′ „ 0″ × 12′ „ 0″
do.	12′ „ 0″ × 12′ „ 0″

Dressing Room, Bath Room, W. C., and Linen Closet.

On the Attic Floor:

Bed Room	22′ „ 0″ × 9′ „ ″
do.	14′ „ 0″ × 9′ „ 0″
do.	15′ „ 0″ × 9′ „ 0″
do.	14′ „ 0″ × 12′ „ 0″
Prospect Room	6′ „ 6″ × 6′ „ 0″

Eight Closets.

The Roof slopes into these Rooms, and they are lighted by Dormer Windows.

The cost of construction will vary according to the part of the country in which the houses are erected, and the many other circumstances on which we have repeatedly commented. If they are erected of stock bricks, with second malm facings on the principal front, and decorations in cement as shown, the outlay for the two dwellings will not be less than £ 3000. The omission of the cement work will involve a considerable deduction.

DESIGN FOR A DETACHED VILLA.

Plates 64. 65. 66.

are designs for a detached Italian Villa, adapted for a frontage of 40 feet. The treatment adopted is astylar (that in which the effects are obtained chiefly by means of flat surfaces, columns, always expensive features, being avoided); and if the site be elevated and perfectly isolated, the varied elevations, with their picturesque breaks and recesses, would appear to the greatest advantage. A tower, if not an indispensable feature in this class of habitations, must, at least, be allowed very considerably to enhance the general effect; and the manner in which it is in this instance obtained, by means of a single break on the ground level, and the utilization of its space, reduces the consideration of the trifling extra cost of carrying it up to the desirability of the upper apartment, which may be used either as a sitting or a smoking room, according to the taste of the proprietor, the windows commanding a full view of the country around.

The residence is suitable for a gentleman of moderate income, with a small family and two or three servants. The kitchen department is kept perfectly separate and distinct; and, on closing the door communicating with the hall, all unpleasant odour, arising from cooking or other causes, is completely shut out. There is a side entrance for tradesmen, and an appropriate and convenient arrangement of the servants' offices; a point, the importance of which, as conducing much to the comfort and well-odoring of a household, is too frequently overlooked. A basement, with coal and wine cellars, is placed beneath the kitchen.

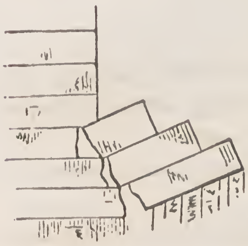
The materials to be used in the construction will, of course, entirely depend on the part of the country in which the house is erected, stone being in some districts cheaper than bricks, and, of these latter, the prices of red, white, and yellow similarly varying. Since the alteration in the duties, moulded bricks have been more generally brought into requisition, and, if brickwork alone is used, the plain surfaces may be of yellow, and the dressings to the windows &c. of red bricks, with tiled roofs, and these would produce a very pleasing result Stone is the most durable and satisfactory material; the description used will depend on what quarries are near. Next to its external use, we should recommend the walls to be faced with second malm stock bricks, the dressings to be of rubbed Portland, Bath, or other stone, as most convenient. For the latter cement may be substituted. Portland is preferable; but Roman or other cement, if of good quality, will be found of a lasting character, which may be still further increased by painting, after it has become thoroughly set and dried.

Fir timber is the best. Riga costs most, but lasts longest. Memel, Dantzic, or Swedish may be substituted for it. Red pine is very durable, but the yellow is not to be depended upon. The Joiner's work should be of deals from Norway, Sweden, or Russia. Much depends on the selection of the timber, and some experienced person should always be consulted. The joists and plates next the ground, and the upper sills of the windows ought to be of oak. None other than English oak should be used: that grown in Sussex is the best.

If the soil is gravelly no concrete will be required in the foundations; if of clay, or at all doubtful, it is recommended of about twice the width of the footings and averaging 1 foot in depth. Gravel is not affected by the action of the atmosphere, but many clays which at first appear firm will, after a short exposure, run into sludge. The concrete should not be thrown, as is usual, from a raised stage. This tends to seperate its component parts, the

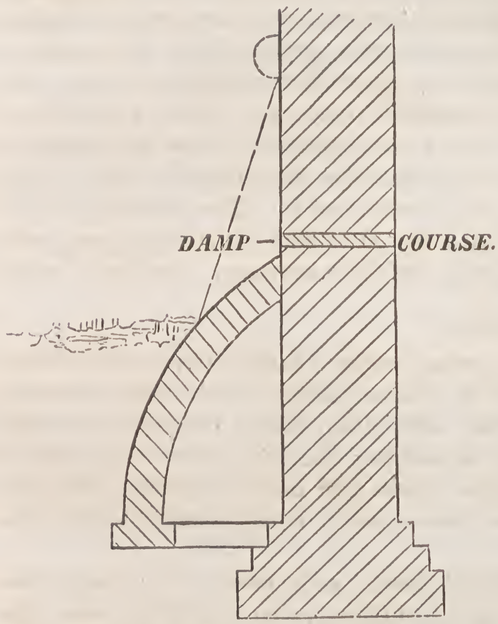
heavier reaching the ground first; and it should therefore be tipped over from the lowest possible level.

The footings should be carefully constructed, as on them the whole weight of the building rests. The bottom courses ought invariably to be double, and the projection of one beyond the other not more than 3 inches, otherwise the consequence shown in the margin will probably occur, and a settlement take place.



In houses of this description in which the living apartments are next to the ground level, the prevention of damp becomes a very serious consideration.

The most effectual mode of prevention is one that is somewhat expensive, but when the great inconvenience resulting from damp is considered, as well as its effects on the health of the inmates of the house, the steady destruction caused by it to the timber, and the deterioration of the furniture and fittings, perhaps no means, at wathever cost, should be deemed otherwise than of absolute necessity for the avoidance of so great an evil. The method we recommend is to turn a half-brick arch, in the manner illustrated in the diagram, all round the building. As damp almost always rises through the walls, if there is concrete below the footings, it will be perceived that no ground rests against the main brickwork; and the prevention of the annoyance may be effected by laying, a few inches above the ground level, throughout the thickness of the walls, either a layer of Claridge's Seyssel asphalte, say $^3/_8$ inch thick; a layer of coarse slate slabs bedded in $^3/_4$ inch cement with an $^1/_2$ inch course over; or a layer of cement alone one inch in thickness. Lead is the best, but at the same time the most expensive material. In the present instance, the level of the principal floor is raised 2′ „ 6″ above the surface of the ground, and, if the site is not very damp indeed, either of the layers above mentioned will be found, of themselves, sufficiently effectual. Dry rubbish, mixed with lime, should be strewed over the surface of the ground within the walls.



The locality in which an edifice is built will, as a matter of necessity, very considerably modify the cost of its construction. The prices of materials and the rates of labour are also continually undergoing changes, which render an estimate applicable only to the time and place for which it is made. The design given, if erected in the suburbs of London, or in the home counties, in accordance with the subjoined specification, of stock bricks and cement dressings, would cost about £ 900. If the external surface of the walls is cemented, or if second malm stocks with red brick dressings are adopted, the average addition would be £ 28 or £ 30. Stone dressings would increase the expense from £ 100 to £ 150.

The house would probably let, in the environs of London, in a tolerable situation, for £ 60 or £ 65 per annum, and a return of about 7 per cent may thus be calculated on the immediate outlay. In distant parts of the country the figures will stand very different; and sufficient is here given to enable any builder to furnish an accurate estimate of the cost of construction.

SPECIFICATION AND GENERAL DESCRIPTION OF THE DRAWINGS for sundry works to be contracted for in erecting and completely finishing a Villa Residence, with all the fittings appertaining thereto, according to the several plans, elevations, and sections accompanying this Specification and numbered 64. 65. 66.

EXCAVATOR.

Dig out the ground to the depth and width necessary for the several walls, drains, &c. and fill in, level, and well ram the same as the works are brought up, carting away all superfluous earth, and depositing it on such part of the premises as may be required.

The best of the ground is to be selected from the excavations, and wheeled and spread to an uniformly level surface in the garden where directed.

Wherever springs, streams, or soaks of water appear and issue from the sides of the excavations, the contractor is, at his own expense, to take all precautionary measures of draining, damming, stopping, lading, or pumping such water, or otherwise getting rid of it, in order to prevent any injurious effects, either during the progress, or after the completion of the work.

The contractor is to lay a bed of concrete (if required) twice the width of the lowest course of footings, and averaging 1 foot in depth; it is to be tipped over from the barrow at the lowest possible level. If the trenches are got out wider than the intended width of the concrete, they must be filled up with it, and not with earth cast in. The concrete is to be composed of good clean gravel, well incorporated in a dry state with fresh burnt grey stone lime, in the proportion of one of lime to six of gravel, with the necessary quantity of water.

BRICKLAYER.

The whole of the works with the several walls, arches, string courses, sleeper and fender-walls, drains, &c. throughout, are to be executed in the manner shown, and herein described.

The mortar is to be composed of grey stone lime, and clean, sharp screened river sand, perfectly free from saline particles and all other impurities; the proportions in no case to exceed three measures of sand to one of lime, and the whole well chafed together. The lime is to be kept dry, screened with the sand, and no more mortar is to be made at one time than is sufficient for the day's consumption.

The walls are to be built in regular courses, Flemish bond, no 4 courses to average more than 1 foot in height, and no one part of the principal building to be carried up more than 3′ „ 6″ above any other part during the progress of the works, but to be built up uniformly.

No toothing is to be left to unite one part of the wall to another; the walls must be racked back where left off, and the whole regularly and well bonded, with as close beds and joints as possible, and all the return and close joints to be flushed up full with mortar every course. The hardest and best burnt bricks to be invariably selected for the footings; the bottom courses to be double, with no back-joints beyond the face of upper work, except in double courses.

The bricks used to be sound, hard, well burnt, grey stock bricks, of a regular size and shape, without any admixture of soft, place, or other bricks of inferior quality. The most uniform in colour to be selected for the facings, which are to be finished with a neat, close, flat joint.

9 Inch arches over all lintels, doors and windows, to be turned in half-brick rings, breaking joint, and bonded with a whole brick where the joints meet; turn over wine and coal cellars half-bricks arches, the spandrils filled in.

Bed and point all door and window frames; cut all necessary splays, and carefully form chamfers where shown of the elevations. The slanting walls to be neatly cut to take timbers of roofs; particular care to be taken in matching bricks and mortar where seen, and all putlog

holes to be carefully filled with matched bricks. Carry out all corbelling courses for fireplaces, ends of timbers, &c.; bed all wall plates and lintels; cut all skewbacks for arches, and work all requisite projections and cores for cement dressings. Whole bricks only to be used in the footings, and nothing less than half-bricks to be used anywhere. Carefully form all flues and core and smoothly parget the same, keeping them of one uniform size, 14 >< 9 inches. Small openings for air and ventilation to be left in the walls, where pointed out, and to be filled in with cast iron air bricks. Set in scullery a copper and furnace complete, with hard, square, picked bricks, including fire-bricks; the external face colored and tuck-pointed. Provide also fire-lump backs to sitting room fire-places, and fire-brick backs to the remainder. Cover roof over porch with Italian formed tiles, properly fixed, pointed with lime and hair, and finished complete.

Provide and lay from waterclosets 5 inch earthenware socket pipes, in two feet lengths, jointed with well tempered clay and laid with a proper fall towards sewer, and the junction securely formed. The remaining pipes to be 3 inches in diameter, glazed: all to have syphon traps, with all necessary bends, junctions, and every requisite to render the same complete and efficient.

MASON.

The stone to be of the best description, properly worked and set.

Pave the scullery with 2½ inch rubbed York, closely jointed in mortar and laid on hard, dry, well rammed rubbish; or bedded in mortar on dwarf walls.

The steps to Cellars to be formed with treads and risers of 2½ tooled York, pinned into the walls 4½ inches; and the cellars are to be paved with the same, jointed in mortar, and laid on a bed of dry rubbish.

The steps to principal entrance to be of rubbed Portland stone, with moulded front edges; the bottom one solid and the remainder feather edge, properly back jointed, and back rebated for 2½ inch rubbed Portland landing; the whole to be one foot longer than the length of treads, the clear width of which is to be full 11 inches.

The steps to back entrances to be of rubbed York, with square edges; to be 9 inches wider than openings of doorways, with 10 inch treads.

Provide and fix in the scullery a sink 3 feet >< 1 ft. and 7 inches thick and 4 inches deep, perforated and rebated for 4 inch bell trap, and cut and pinned in cement into the wall.

2 Inch Portland slabs 10 inches wide, with rubbed York inner hearths, to be provided for all the fireplaces; that to kitchen to be of York, 2 feet wide.

The Chimney pieces to drawing, dining, and breakfast rooms to be of marble, of patterns to be chosen, of the collective P. C. value of £ 15, exclusive of carriage and fixing. Those to three principal bed rooms to be of the P. C. value of £ 2 „ 10 „ 0 each; the remaining rooms to have Inch ½ Portland jambs and mantles 7″ wide; that in the kitchen to be of rubbed York.

CARPENTER AND JOINER.

The Oak to be of English growth of the best quality, free from sap and all defects, and from trees that can be proved to have been cut down at least two years, sawn die square and well seasoned.

No American or Scotch fir to be used. The yellow fir is to be of the best description, sawn die square and well seasoned, either Riga, Memel, Dantzic, or Swede, of hearty quality, and free from sap, shakes, wainey edges, large, loose and dead knots.

The deals to be equally approved, perfectly sound and well seasoned.

GENERALLY.

All wall plates, lintels, sill-pieces, templates. and wood bricks (except where described to be of oak) to be of yellow Baltic fir of the best quality.

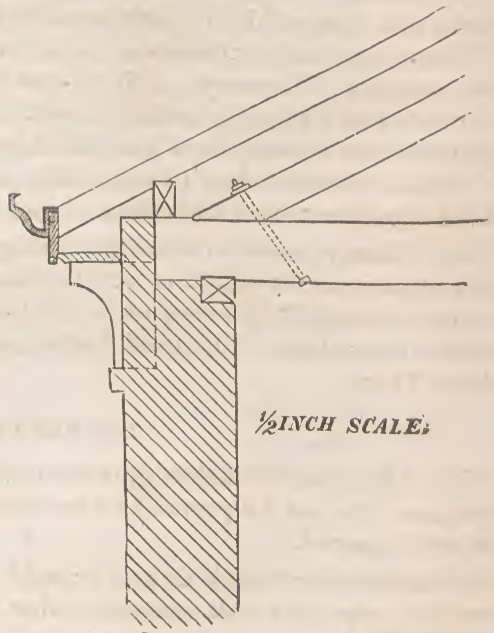
All sashes and frames, external doors and frames, and eaves linings and finishings, and the floors and staircases throughout, and all the finishings of the lobbies and passages, to be of yellow deal, and all the remaining joiner's work to be of white deal.

The whole of the timbers are to be got out to the scantlings and put together in the manner shown on the drawings and described in this specification. No quarters, joists, or rafters are, under any circumstances, to be more than 12 inches asunder. The plates are to be well dovetailed at the angles, and where there are no return plates, the ends are to be well secured to the walls with iron ties, and in all cases to be in one length and well lapped and spiked. No timbers to be notched, cogged down, mortised, or cut otherwise than is directed; lintels, in all cases, to be 18 inches longer than the intended openings; to be 6 inches deep over the folding doors, and $4\frac{1}{2}$ inches in all other situations, properly fixed and set before the arches are turned over. No timber is to be placed within 9 inches of any fire place or flue, and all timbers, where seen, are to be wrought. The floors, partitions, and ceilings are to be perfectly level, fair, and upright before laying the boarded floorings or lathing for plastering; and wherever the bearing of the joists exceeds 10 feet, a row of herring bone strutting should be inserted between the joists.

Provide and fix a sufficient number of fir bricks, $4 \times 2\frac{3}{4}$ inches, to each window and door, where necessary, to attach the finishings. The contractor must also find all requisite centring pieces, moulds, bearers, fillets, firrings, angle staves, and all else that may be requisite to complete the carpenter's work, and make it in every respect fit to receive the finishings of other trades.

ROOFS.

The roofs to be framed and put together in the manner indicated on the drawings, with all necessary tilting fillets valley-pieces, etc. Moulded wood blocks are to be fixed at the distances apart indicated on the elevations and in the margin. The rafters to roof over kitchen and scullery are to project beyond the face of the walls, and the gutters screwed to them. The wood blocks to roof of tower are also to be fixed in a similar manner to those over main building.



SCANTLINGS OF ROOF TIMBERS.

Three trusses, main building.

Binders . . .	8×4	inches.
Principals . .	$4^1/_2 \times 3^1/_2$	„
Struts	$4 \times 2^1/_2$	„
Purlins . . .	5×3	„
Common rafters	$4 \times 2^1/_4$	„
Wall Plates . .	4×3	„
Pole Plates . .	$4^1/_2 \times 2^1/_2$	„

Ridges and Valley-pieces $8 \times 1^1/_2$ inches, with rounded rolls $2^1/_2 \times 2$ inches.
Gutter plate over landing $12 \times 4^1/_2$.

Yellow Fir blocks. Inch deal wrought, ploughed, tongued, beaded, and throated fascia and soffite, securely fixed. Inch wrought iron king bolts, with dovetailed formed heads, and $^3/_4$" wrought iron screw bolts to feet of principal rafters; all to have proper nuts, washers, plates, etc. complete. The bolts to be square, as fitting tighter.

Roof over Kitchen and Scullery.

Rafters . .	$4^1/_2 \times 2^1/_2$	inches	
Collars . .	$4^1/_2 \times 2^1/_2$	„	
Plates . . .	4×4	„	
Ridge . . .	$8 \times 1^1/_2$	„	with rounded roll $2^1/_2 \times 2$ inches.

Roof over Tower.

Rafters	$4 \times 2^1/_4$	inches
Collars	$4 \times 2^1/_4$	„
Plates	4×3	„
Angle pieces . .	$7 \times 1^1/_2$	„

Tilting fillets, feather-edged, to the gables, and wherever necessary. The roofs to be all covered with $^3/_4$ inch battens, $2^1/_4$ inches wide, laid for countess slating.

The gutter to be laid to a fall of 2 inches in 10 feet. Inch Yellow deal gutter boards, edges shot, with fair surfaces, and 9 inches in width; proper bearers fixed to the rafters.

SCANTLINGS OF FLOORING AND CEILING JOISTS.

Ground floor.

Oak joists . .	4×3	inches
„ Plates . .	4×4	„

Over cellars, fir joists $7'' \times 2^1/_2''$, with plates $4'' \times 3''$.

Chamber floor.

Main building.

Joists $9 \times 2^1/_2$ inches.
Trimming joists and trimmers 9×3 inches.
Plates 4×3 inches.

Tower.

Joists $5 \times 2^1/_2$ inches.
Trimming joists and trimmers 5×3 inches.
Plates 4×3 inches.

Closets.

Joists $5 \times 2^1/_2$ inches.
Plates 3×3 „

The floors to drawing, dining, and breakfast rooms to be Inch $^1/_2$ Yellow, straight joint, batten floors, with splayed heading joints and mitred borders to slabs. To hall and passages Inch $^1/_2$ Yellow deal straight joint floors. The floors to kitchen, larder, and closets to be Inch $^1/_2$ Yellow deal laid folding. Those to Chamber floors to be Inch $^1/_4$ Yellow deal straight joint, with mitred borders to slabs.

The ceiling joists throughout to be $3^1/_2 \times 2^1/_4$ inches, with bearers, where essential, $7 \times 2^1/_2$ inches, properly secured to the wall.

SKIRTINGS.

The Skirtings to drawing, dining, and breakfast rooms to be Inch $^1/_4$ moulded and sunk, 13 inches girt. That to entrance passage and hall to be 9 inches high, with moulding 3 inches girt. The kitchen, scullery, back passage, larder and W. C. to have square skirting, 7 inches high. Put torus moulded skirting, 8 inches high, to rooms and landing on first floor; that to closet to be square, and the same to the rooms on the upper floor. The skirtings to be fixed with narrow grounds, and the mitres properly formed.

PARTITIONS.

The partitions on the chamber floors are to be framed, braced, and securely put together with head and sills $4'' \times 3''$; posts $4'' \times 4''$, braces $4'' \times 3''$, and quarters $4'' \times 2''$, 14 inches from centre to centre.

STAIRCASES.

Inch $^1/_4$ Yellow deal treads and risers, with moulded and returned nosings. Strong fir carriages, glued, blocked, tongued, and bracketted for plastering. Inch $^1/_4$ moulded wall string, ramped and kneed, so as to be one uniform height above the nosings, and into which the steps are to be housed and well wedged up in glue. Inch $^1/_4$ sunk, cut and beaded apron linings. Inch moulded skirting and narrow grounds on quarter spaces, and curtail end to bottom steps. Good bright Honduras mahogany handrail $4'' \times 2''$, ramped, writhed, and moulded, with square bar balusters, two to each step, every fourth one to be of wrought iron, with plates at top and bottom to secure it to handrail and steps, with counter-sunk holes and screws. The handrail and newels to be French polished in the best manner.

The staircase to upper apartment in tower to have Inch Yellow deal rounded steps, risers and winders, on strong fir carriages, firmly bracketted, and properly glued and blocked. Inch square wrought deal string boards, into which the steps are to be housed and all made complete and perfect. Deal rounded handrail on one side against the partition, secured with iron brackets.

DOORS.

The principal entrance door to be $2^1/_2$ inch, 4 panel, bolection moulded one side and bead flush the other, fir proper door-case $4^1/_2'' \times 4''$ extending round fanlight, and with ogee bead architrave all round. Transom $4'' \times 3''$, double rebated and beaded both edges, with moulded impost, and 2 inch moulded frame for fanlight. The door to be hung on 2 — 4 inch wrought iron butts, and to have a good solid-warded 12 inch draw-back lock, with brass knobs and large size bronze knocker. Inch $^1/_2$ oak steps and inch riser.

The back entrance door to be of 2 inch deal, bead butt both sides, hung to solid, rebated and beaded frame $4'' \times 4''$. A beaded, and rebated transom is to be fixed 6′ 6″ above the steps, with inch fan-light, with cords to open and shut the same. The upper panels of the door are to be sashes, with inch bead butt lifting shutters, with proper stub-places and and thumb screws for securing the same. 10 inch draw back lock with brass knobs and 2 — 8 inch barrel bolts. Inch $^1/_2$ rounded oak step and riser, and ogee bead architrave round inside of doorway.

The external door of scullery to be of Inch $^1/_2$ deal square framed, hung with $3^1/_2$ inch butts to fir proper door case $4'' \times 3^1/_2''$, and to have an iron rim two-bolt knob lock, and two 8 inch bolts.

The doors into dining, drawing, and breakfast rooms, including those hung folding, are to be 2 inch, 4 panel, moulded both sides, hung on 3 inch brass butts to inch $^1/_4$ double rebated and beaded linings. Inch framed grounds $4^1/_2$ inches wide and moulded architraves on both sides 7 inches girt. Each door to have a 6 inch $^5/_8''$ mortice lock, with ebony furniture and finger plates on both sides.

The door leading from hall to servants' offices to be Inch $^1/_2$ moulded towards hall and bead-butt, hung with 3 inch brass butts to Inch $^1/_4$ single rebated and beaded lining, with grounds and architrave towards hall, to correspond with the doors above described. 6 inch mortise lock, with ebony furniture and knob bolt on side of hall.

The door indo W. C. to be Inch $^1/_2$ moulded and square, similarly hung and finished as the above, with brass W. C. latch, round knob and secret bolt.

The remaining doors on ground floor to be of Inch $^1/_2$ deal, square framed, hung with $3^1/_2''$ butts to inch $^1/_4$ rebated and rounded linings, and provided with 6 inch iron rim, 2 bolt, knob locks; that to closet for brushes and brooms to have only a brass turnbuckle.

The door into wine cellar in basement to be an Inch $^1/_2$ framed, ledged, and braced door, filled in with $^3/_4$ battens, and hung to wrought and rebated frame 4×4 with $4''$ wrought iron butts. It is to have a good $10''$ stock and plate wine lock, copper wards and pipe key.

The door into principal bed rooms and dressing rooms, on first and second floors, to be Inch $^1/_2$ moulded both sides doors, hung with wrought iron hinges to $1^1/_4$ double rebated and rounded linings. Inch framed grounds $4^1/_2$ inches wide, with moulded architraves 7 inches girt on both sides. They are all to have 6 inch mortise locks with brass handles. The door into W. C. to correspond externally with the others, and to be otherwise similar to the one below.

The doors to rooms and closets in tower to be Inch $^1/_2$ square framed doors, hung with $3^1/_2$ inch wrought butts to Inch $^1/_4$ single rebated and double rounded linings. They are all to have 6 inch iron rim, 2-bolt, knob locks. The entrance to the stairs leading to the upper apartment of the tower is not to have any door.

WINDOWS.

All the windows so shown to have circular heads.

The windows in drawing, dining, and breakfast rooms to have Inch $^1/_2$ ovolo sashes, double hung with white lines, iron weights, brass cased pullies, and sash fastenings. Deal cased frames, oak sunk sills, $1''$ deal outside and inside linings, with $1^1/_4''$ wainscot pulley-pieces and parting beads, and $^7/_8''$ inside beads, returned on sill, and fixed with gilt headed screws.

Inch $^1/_4$ — 4 panel moulded and bead butt shutters, on splay, and inch bead butt and square back flaps. The front shutters to be hung with 3 inch brass butts, and the back flaps with 2 inch flap hinges. Inch 2-panel bead butt back linings, tongued to frame. Inch $^1/_4$ proper boxings, and moulded architraves 7 inches girt, with inch $^1/_4$ one panel moulded soffites. Inch $^1/_4$ moulded window backs, with tongued and beaded cappings continued over inch jamb linings on splay. Each window to have an iron spring bow shutter bar, with two ebony shutter knobs. The skirting to continue round windows.

The windows in kitchen and scullery to have deal cased frames, and inch $^1/_2$ ovolo sashes, double hung, with iron weights, sash fastenings and pullies. Inch tongued and rounded linings and rounded cappings. Inch $^1/_4$ two, and one panel, bead butt and square shutters, hung on 3 inch wrought butts, and having a wood latch shutter bar.

The windows to larder and W. C. to have fir proper frames $4^1/_2'' \times 3''$, with Inch $^1/_4$ ovolo sashes hung on centres with cut beads and fastened by flush bolts. $^3/_4$ inch rounded linings and soffites, and inch rounded window boards. The sills to be of oak, sunk.

The staircase windows to have solid frames $4'' \times 4''$, with inch $^1/_2$ fixed ovolo sashes, and linings, soffite, and window boards as above.

The two windows lighting basement to have oak solid frames, and oak chamfered sashes, inch $^1/_2$ thick, one of them to be fixed, the other to be hung on pivots, so as to remove and form coal shoots: an iron bolt to be fixed within. Or iron gratings, one hung on hinges, may be substituted.

The bed room windows to be similar to those in sitting rooms. The shutters are to be omitted, and the jamb linings and soffites finished with a large bead at the angle. The windows to bed rooms in tower will have no window backs, but inch rounded linings, soffites, and window boards. Those to closets to be as described for Larder.

CLOSETS.

The water closets to have inch $^1/_4$ deal seats and risers, on fir proper framed bearers and grounds, fixed with screws and made to shift, so as to get at the apparatus. Inch $^1/_4$ deal beaded frames, morticed and clamped flaps, hung with $2^1/_2$ brass butts, and $^3/_4''$ skirting 5 inches wide round three sides of seat. Cut hole in seat and for handle, the latter beaded.

The closets in Dining and Bed rooms to be formed of inch $^1/_2$ framing, with Inch $^1/_2$ moulded and square doors, and finishings and furniture similar to the other doors in the rooms; to have good closet locks, and to be hung with $3^1/_2$ inch brass butts. They are to be fitted up with shelves of inch deal as desired.

SUNDRY FITTINGS.

The Cistern to be placed in the tower roof. It is to be 6 feet by 4′ „ 6″ and 2′ „ 3″ deep. Inch $^1/_2$ wrought, ploughed, tongued, and dovetailed lining, with fir wrought bearers, and one wrought iron bolt, $^1/_2$ inch in diameter, with nut and screw complete. Binders below cistern $10'' \times 4''$. A step ladder is to be provided to get at the cistern, and a small opening formed in the ceiling, with ledged flap, hung on cross-garnet hinges, with a small bolt. A cistern 3′ × 0″ × 2′ „ 6″ × 1′ „ 6″ is to be similarly fitted up over W. C. on ground floor, with flap in ceiling to get at it.

Provide and fix in kitchen a dresser, 6 feet long × 2′ „ 6″, fitted up with drawers, shelves, and every requisite complete.

Provide also a strong plate rack, 3 feet long, over sink; $^7/_8''$ double beaded rails $3^1/_2$ wide and 6 feet long for dish-covers; a legded cover to copper; inch $^1/_4$ clamped ironing board and frame hung on hinges under windows, with iron legs; and $^3/_4$ beaded bell board 11 inches wide.

Fix on apex of tower a turned ornamental finial.

SMITH.

$4^1/_2$ Inch moulded eaves gutters screwed to deal fascia, and to be cast and fixed so as to secure a fall.

$3^1/_2$ Inch Iron rain water pipes, with cistern heads, and properly connected with drains.

Fix (if required) to small windows on ground floor $^7/_8$ inch bolts of wrought iron, 5 inches apart, properly secured.

The bolts, etc. to roofs are specified in the carpenter's description.

Wrought iron chimney bars $2^1/_2'' \times {}^1/_2''$ to all fireplaces to be 18 inches longer than openings, and turned up into brickwork.

The stoves to be selected, and a price named for setting.

PLASTERER.

The internal plastering to be executed with well burnt chalk lime, of good quality, well incorporated with clean, sharp, drift sand and strong hair.

The laths to be strong lath and half laths, nailed at both ends with cast iron nails.

Lath the partitions and ceilings, render the walls, and float, set and finish for paper, and white the ceilings.

Twice limewhite the walls of cellars and stairs leading to them; also the kitchen, scullery, pantry, and closet for brooms.

Run cornices to drawing, dining, and breakfast rooms 12 inches girt, with one enrichment to each $2^1/_2$ inches girt; the cornice to principal entrance and hall to be 9 inches girt; and to the landing and three bed rooms and dressing room on first floor, put cornices 7 inches girt.

The external dressing are to be run, moulded, and finished in Portland cement of the best quality, in the porportion of one of cement to 3 of clean sharp sand. Provide and fix approved vases for flowers to principal entrance and perforated ornament to balconies.

PAINTER.

The white and red lead, oil, and turpentine to be of the best quality. The graining to be of superior quality, and the varnish to be the best hard drying copal.

All exterior wood and iron work to be painted four times in oil colors; as also all interior wood work where seen, finished some common color to match the papers, except where otherwise described.

The principal entrance, hall and staircase to be grained wainscot and twice varnished.

The drawing room to be grained satin wood, and the dining and breakfast rooms grained maple, and twice varnished.

The stone chimney pieces are to be painted 4 times in oil, and, in principal bed rooms, grained in imitation of dove, or other marble, and twice varnished in copal.

The external face of principal entrance door, is to be grained extra dark oak and twice varnished.

PLUMBER.

The lead to be all milled and of the best quality. The hips and ridges to be covered with 5 lb. lead 13 inches wide. Flashings of 5 lb. lead round chimney shafts and to valleys 6 inches wide, and step flashings up gables laying 2 inches into joints of brickwork and showing 4 inches on the face. The gutter to be laid with 7 lb. lead, falling 2 inches in 10 feet, with cesspool 4 inches deep.

The Cistern is to be lined at the bottom with 7 lb. lead and the sides with 6 lb., turning over the top edges $1^1/_2$ inches, and supplied by inch $^1/_2$ rising main; to have a trumpet mouthed standing waste pipe 2 inches diameter, and 2 inch brass washer and waste, with 2 inch waste pipe into trap of upper W. C.

The water to be conducted to this by $^3/_4''$ service pipe, with inch service pipe to smaller cistern over W. C. on ground level, which cistern is be fitted up on a similar manner to the one above described. Provide and fix also from upper cistern an inch supply pipe to the sink on scullery with brass cock, 4″ brass grate and bell-trap and $2^1/_2$ waste pipe.

The water closets are to be fitted up with strong pan closet apparatus, white basins, strong *D* traps, cramps, levers, and every requisite complete. 4 Inch lead soil pipes delivering into drains and properly trapped.

GLAZIER.

The drawing, dining, and breakfast room windows to be glazed with patent plate or sheet glass, 21 oz. to the foot super, as also the sash entrance door. The remaining windows to be glazed with the best double crown glass: the basement windows to have thirds crown. All the glass to be well bedded and puttied and thoroughly cleaned off.

SLATER.

Cover the roofs with Bangor countess slating, nailed with zinc nails (iron being liable to rust, and copper, the best, are expensive), two to each slate; the eaves to be double.

PAPERHANGER.

The principal entrance hall and staircase to be hung with good Sienna marble paper, twice sized and varnished in the best manner. The remaining papers will be chosen and a price is to be named for hanging them complete.

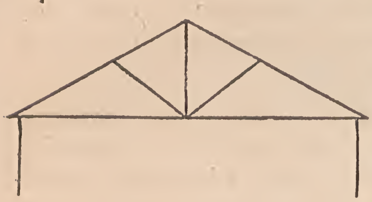
BELL HANGER.

The sitting rooms to have two sunk lever pulls and the 6 principal bed rooms one each, to correspond with the furniture of the respective rooms. The back entrance is also to have a sunk pull. The wires are to be conducted to the bell-board in the passage; they should be of copper, and each bell is to have a small neat brass pendulum. Provide also metal tubing from the pulls down to the floor.

No enclosing walls or railings are included in the estimate given. Their necessity and extent will entirely depend on circumstances of which it is impossible for us to take cognizance.

THE CONSTRUCTION OF ROOFS, FLOORS, AND PARTITIONS.

Few matters are of more importance to the Practical Builder than the construction of Roofs, which not only cover and protect buildings but also bind them firmly together. The principles involved in the combination of their parts have been generally stated in the article on the Mechanical Principles of Carpentry. Rafters placed, as in the outline in the margin, without the *collar* or *tie*, would naturally tend to thrust out the walls, and if the span is about 30 feet, the next combination should be adopted. The tendency of the *tie-beam* to bend or sag in the middle is prevented by the *King-post* in the centre; and the *struts* perform a similar office for the principal. The combination altogether is termed a *truss*. "In general the carpenter should avoid as much as possible all cross strains, or those which are transverse, and in the arrangement of the timbers of a roof, he should never employ a very open angle at a point where a load is to be supported, the obliquity of the two pieces forming the angle requiring them to exert a great force, in order to oppose a much smaller one."



The various inclinations given to roofs is dependent on the climate in which they are erected. In the countries of the East, in Egypt, and some parts of Italy they are constructed flat; as well for the convenience of enjoying the air as from the circumstance that there are not such vicissitudes of weather as in Northern climes. In proportion to the prevalence of rain and snow, the pitch of a roof is made more acute, graduating to a more obtuse angle as these diminish. In high pitched roofs the wind does not so readily obtain access between the slates or interstices of the lead and is thus not so likely to strip them and introduce rain between the timbers. Where however there are parapets, a high roof is attended with many disadvantages; the snow slides down, and stops the gutters, and in very heavy rains the water falls with such velocity that the pipes cannot carry it off sufficiently rapidly. The materials with which roofs are covered must also be taken into consideration in deciding on the slope, which in this country is rarely above one third of the span or less than one sixth. Pan tiles do not require so much inclination as flat tiles or slates, as the hollows are so many separate channels and facilitate the escape of water. When the inclination is trifling slates will be found almost as wet up a certain portion of their under part as above, as the water flows up by capillary attraction, and it is also thus when snow is gradually melting. Roofs in the South of France, covered with hollow tiles, have a very slight slope which is invariably made greater when slates or plain tiles are employed. The ordinary pitch for slates in this country is when the height of the roof is one fourth of the span or at an angle of $26^1/_2$ degrees. If we take this as a standard the following table will give the degree of inclination for other materials.

Kind of Covering	Inclination	Height in parts of Span	Weight per Square
Lead or Copper	3^0. 50′	$^1/_{48}$	Lead . . . 700. Copper . 100.
Plain Tiles	29. 41′	$^2/_7$	1624.
Pan Tiles	24. 0′	$^2/_9$	840.

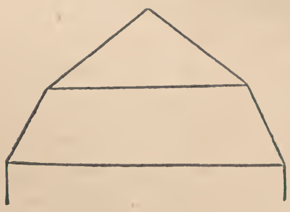
The slope of the roof of the Parthenon at Athens is 16^0; that of the temple of Septimius Severus in Rome, 23^0; and we observe that in England the slope usually given is 27^0 for pan tiles, 25^0 for

plain tiles, and 33° for slates. Vitruvius tells us that the roofs of the ancients were sometimes covered with reeds, and occasionally with clay mixed with straw, and Pliny remarks that the shells of tortoises were sometimes used. In Germany and Switzerland shingles of oak and fir are in constant requisition.

In practice roofs are generally made too heavy. Ware remarks in his "Complete body of Architecture;" — "There is no article in the whole compass of the Architect's employment that is more important or more worthy of a distinct consideration than the roof. The great caution is that the roof be neither too massy nor too slight. Both extremes are to be avoided, for in architecture every extreme is to be shunned, but, of the two, the overweight of roof is more to be regarded than too much slightness. This part is intended not only to cover the building, but to press upon the walls, and by that bearing to unite and hold all together. This it will not be massy enough to perform if too little timber be employed, so that the extreme is to be shunned. But in practice the great and common error is on the other side; and he will do the most acceptable service to his profession who shall show how to retrench and execute the same roof with a smaller quantity of timber; he will by this means take off an unnecessary load from the walls, and a large and useless expense to the owner." Nearly all old roofs are too heavily constructed. In those in Sussex and Kent, the carpenter seems to have coalesced with the mason, for many of the forms are clearly derived from works executed in stone.

We observe in Gothic roofs the rafters placed flatwise, instead of with the depth the other way, as in all scientific constructions; and this fault is copied by many architects of the present day, who permit a blind love of mediævalism to stand in the place of the teaching of science, forgetting that nothing can be beautiful which is scientifically incorrect. The timber houses and roofs of Switzerland, though sometimes too heavy, are generally admirable and cheap constructions, deserving of attentive study. In many old buildings of Brittany the roofs are very simple, in the form of a pointed arch, and in Germany fir planks are often united in this shape and on which structure the rafters and purlins rest. In Holland something of the same system is frequently adopted, the principals being framed of solid timbers arranged about 12 feet apart.

We shall now consider the forms of roofs most generally employed and consequently of the greatest importance to our readers. The simplest form is that termed a shed, or lean-to, in which one side of a building being higher than another, rafters are laid across in the form of an inclined plane: this is of course only suitable for narrow spans. Rectangular buildings are therefore usually covered by roofs in the form of a prism, on the height or pitch of which we have before remarked. When the sides of these roofs are not carried up till they meet, but are finished in a plane parallel to the horizon, they are termed *truncated*. If a roof is not terminated at the ends by gables, but slopes off, the intersection of the slopes is called a *hip*, the rafters at the angles are called *hip rafters*, and the short ones at the side *jack rafters;* the central long one being also a *hip rafter.* The Mansard, or Curb roof (vide outline), is frequently used for the purpose of keeping down the height of the walls of a building and, at the same time, obtaining sleeping or other apartments in the roof, the principals must be carefully secured at their feet, as there is an evident tendency in roofs of this description to thrust out the walls.



When a roof is so formed that its vertical section is a regular curve, and all its horizontal sections are concentric with its plan, it is termed a dome, and this derives its name according to various plans and sections. Thus there are *circular*, *elliptical*, *polygonal*; and of the circular, *spherical*, *spheroidal*, *ellipsoidal*, *hyperboloidal*, *paraboloidal*, etc.

Domes which rise higher than the radius of the base, are termed *surmounted*; those whose height is less than the radius, *diminished* or *surbased;* and those with circular bases, *cupolas.*

The ordinary form is the *spherical;* the plan being a circle and the section a segment of a circle, with the top often finished with a *lantern.*

Mr. Gwilt mentions in his Enciclopædia an ingenious mode of constructing domes, invented by Delorme. "It is a very simple method, and of a great use in domes, even of large diameter, the principle being that of making the several ribs in two or more thicknesses, which are cut to the curve in lengths, not so great as to weaken the timber, and securing these well together, by bolts or keys, and observing especially to *break* the joints of the several thicknesses. This method was adopted in the large *Halle aux blés* at Paris, which was many years since destroyed by fire, and which has been replaced by an iron ribbed dome. The scantlings of the ribs, as given by Delorme, are as under:

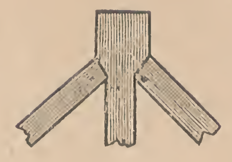
For Domes of	24	feet diameter,	the ribs to be	8	inches deep and	1	inch thick.
"	36	"	"	10	"	$1^1/_2$	"
"	60	"	"	13	"	2	"
"	90	"	"	13	"	$2^1/_2$	"
"	108	"	"	13	"	3	"

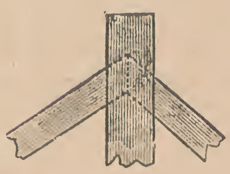
There are no horizontal cross-ties, and the springing of each rib must be well secured at the foot."

It does not come within the scope of this work to make many observations on the high pitched roofs common in the Middle Ages and now reproduced in Church architecture. They were often defective as specimens of construction, in causing a great thrust on the walls, usually counteracted by means of buttresses, instead of by a tie-beam, the use of which would not have harmonised with the soaring effect aimed at by the mediæval architects; although in a certain period of Gothic Architecture flat-roofs, almost resembling floors, and by no means rising to the rank of trusses, were in constant requisition.

In the fifteenth and sixteenth centuries some very elaborate and magnificent roofs were constructed, and that more especially over Westminster Hall deserves the attentive study of the carpenter.

Oak and Chesnut-timbers, pinned and morticed, were in use for these roofs; fir being too liable to split to be of much utility where straps and bolts were repudiated. Trussed roofs, which do not exert a side thrust on the walls, are prefered at the present day, and these are mostly modifications of the principles stated and the wood cuts given at the commencement of this article. The king or queen-post roof is so admirable and is capable of so many variations to suit diverse purposes that it will probably ever continue to be adopted. In these roofs (see plates 15 and 17) the horizontal timbers which extend from wall to wall, are termed *tie-beams,* and they rest at the ends on *wall plates.* The central vertical piece is called the *king-post;* and if there are more than one of these, they are termed *queen-posts.* The lower inclined timbers, rising from each extremity of the tie-beam until they meet the king or queen-posts, are named *principal rafters;* and those inclined mutually in opposite directions from the base of the king or queen-posts to support the principal rafters are the *struts.* The timbers above and parallel to the principal rafters, running in the same direction, are the *common rafters,* which are framed into the *ridge piece,* running along the apex of the roof, the *pole plates,* resting on the tie-beam, nearly over the wall plates, and one or more *purlins,* which are the horizontal timbers resting on the principal rafters betwen the pole plate and the ridge piece. When, instead of one vertical piece in the centre, the roof is trussed by two upright suspending posts, the combination is termed a *queen-post roof;* and the piece between the queens, which acts as a straining piece, is called a *Collar.* It must be clear to the reader that with a little modification of the roofs above described, a great variety may be easily produced, but the increase of struts and rods has a limit in practice, on account of the compressibility of the fibres of timber; but the more the weight is caused to act *in the direction of the fibres,* the less will be the compression. The ordinary form given to the





head of the king-post is defective, in as much as the fibres being vertical, are compressed by the pressure of the principals, and consequently the king-post and tie must always have an inclination, more or less, to descend. The king-post is best made of oak, which is less compressible than fir; or in those of fir, the fibres may abut against one another, but cast-iron king-posts are, after all, the most appropriate. In Plate 17. a variety of useful forms of trusses is given, some with one or more floors in the roof, others adapted for open roofs, or to take ceiling joists. The scantlings of the timbers will be varied according to the span and the covering material. Figs. 1 and 6. are suitable for open roofs, where height is an object; fig. 2 is a form of the *Mansard* or *Curb-roof*, allowing of apartments within it; fig. 3. is adapted for many agricultural purposes, as barns etc., where two or more floors will be useful in the roof. Fig. 4. is a design for a roof by A. H. Houldsworth Esq., which obtained a medal from the society of Arts. The arch is formed of bent pieces cut lengthways in their grain by a saw to within two feet of one end, then placed in a steam kiln and boiled till they will bend freely, when they are fixed in a mould and left to cool, after which a few pins of wood are driven through them to keep the pieces from flying open. The lower end of each arch is inserted in the beam of the floor, and they are both firmly pinned together at the top where they cross one another, and each butts against the opposite rafter: they are further secured by iron straps at *A* to short pieces *B*. Fig. 5. is a curved roof adapted for the top of a turret or other situation. Fig. 7. is a simple form of roof suitable for ordinary dwelling houses, where there are no attics, and the ceiling joists are notched on to the tie-beam. As king and queen-post roofs are those most generally used, we shall give some rules from Mr. Cresy's Encyclopædia for determining the scantlings of the different timbers.

The scantling of the king-post is found by multiplying the length of the post in feet by the span in feet, and again this product by 0.12 for fir, and 0.13 for oak, which latter product will be the sectional area of the king-post in inches; by dividing this area by the breadth, or by the thickness, either may be obtained; the area divided by the breadth gives the thickness, and divided by the thickness gives the breadth.

For the scantling of the principal rafters when the king-post is in the middle, multiply the square of its length by the span in feet, and divide the product by the cube of the thickness in inches: for fir multiply the quotient by 0.96 which will give the depth in inches.

For struts and braces, multiply the square root of the length supported in feet by the length of the strut in feet, and then multiplying the square root of the product by 0.8 for fir, the depth may be obtained, which multiplied by 0.6 will give the breadth in inches.

Common rafters are usually made 2 to $2^1/_2$ inches in thickness, and their depth is found by dividing the length of bearing in feet by the cube root of the breadth in inches, and multiplying the quotient by 0.72 for fir, or 0.74 for oak, to obtain the depth in inches.

The scantlings of purlins must be proportioned to the distance the trusses are apart. By multiplying the cube of their length in feet by the length of bearing in feet, the fourth root of the product will be the depth in inches for fir; or multiplying by 1.04 will give the depth for oak; this multiplied by 0.6 will give the breadth.

In queen-post roofs the mode of finding the scantling of one of the suspending pieces is to multiply its length in feet by the length of the tie-beam in feet, and then multiply the product by 0.7 for fir, or 0.32 for oak, to obtain the sectional area in inches of the post: if we divide this area by the thickness in inches, the breadth will be obtained. In order that the strength of the straining piece between the heads of queen-posts may be as great as possible, its depth should be to its thickness as 10 to 7: by multiplying the square root of the span in feet by the length

of the straining piece in feet, and then extracting the square root of the product and multiplying it by 0.9 for fir, the depth in inches may be found; to find the thickness multiply the depth by 0.7.

Such are the rules generally adopted for finding the scantlings of roof timbers. The following is the summary of practice adopted by Gwilt, and will be found extremely useful in saving the labour of calculation.

As we do not propose to dilate on iron roofs, it will complete the observations we deem needful, in addition to those previously made, on the construction of the framed coverings of buildings. We need only remark, that oak is more cohesive than fir, but fir is less compressible than oak by forces acting in the direction of its fibres: oak is therefore best for ties and kings and queens, and fir for struts and straining pieces.

For roofs whose spans are between 20 and 30 feet, no more than a truss with a king-post and struts will be necessary, in which case the scantlings hereunder given will be sufficient.

For a span of 20 feet, the tie-beam to be 9 in. by 14 in.; the king-post 4 in. by 4 in.; principal rafter 4 in. by 4 in.; struts 4 in. by 3 in.

For a span of 25 feet, the tie-beam to be 10 in. by 5 in.; the king-post 5 in. by 5 in.; principal rafter 5 in. by 4 in.; struts 5 in. by 3 in.

For a span of 30 feet the tie-beam to be 11 in. by 6 in.; the king-posts 6 in. by 6 in.; principal rafter 6 in. by 4 in.; struts 6 in. by 3 in.

For roofs whose spans are between 30 and 45 feet, a truss with two queen-posts and struts will be required, and a straining piece between the queen-posts. Thus—

For a span of 35 feet, the tie-beam to be 11 in. by 4 in.; queen-posts 4 in. by 4 in.; principals 5 in. by 4 in.; straining piece 7 in. by 4 in.; struts 4 in. by 2 in.

For a span of 45 feet, the tie-beam to be 13 in. by 6 in.; queen-posts 6 in. by 6 in.; principals 6 in. by 5 in.; straining piece 7 in. by 6 in.; struts 5 in. by 3 in.

For roofs whose spans are between 45 and 60 feet, two queen-posts are required, and a straining piece between them, struts from the larger to the smaller queen-posts, and struts again from the latter.

For a span of 50 feet, tie-beam 13 in. by 6 in.; queen-posts 8 in. by 8 in.; small queens 8 in. by 4 in.; principals 8 in. by 6 in.; straining piece 9 in. by 6 in.; struts 5 in. by 3 in.

For a span of 55 feet, tie-beam 14 in. by 9 in.; queen-posts 9 in. by 8 in.; small queens 9 in. by 4 in.; principals 8 in. by 7 in.; straining piece 10 in. by 6 in.; struts $5^1/_2$ by 3 in.

For a span of 60 feet, tie-beam 15 in. by 10 in.; queen-posts 10 in. by 8 in.; small queens 10 in. by 4 in.; principals 8 in. by 8 in.; straining piece 11 in. by 6 in.; struts 6 in. by 3 in.

The scantlings of purlins are regulated principally by their bearings, and though we have subjoined scantlings of bearings for 12 feet, such should be avoided by not allowing the distance between the trusses to exceed 10 feet.

For a bearing of	6 feet,	the scantling of the purlin should be	$6'' \times 4''$.
"	8 "	"	$7'' \times 5''$.
"	10 "	"	$8'' \times 6''$.
"	12 "	"	$9'' \times 7''$.

For common rafters, the scantlings are as follow; 12 feet should be the maximum of the bearing.

For a bearing of	8 feet,	the scantling of the rafter should be	$4'' \times 2^1/_2''$.
"	10 "	"	$6'' \times 2^1/_2''$.
"	12 "	"	$6'' \times 2^1/_2''$.

Plates may be 4, 5, or 6 inches square according to the size of the roof.

On the outward casings of roofs we have previously made some casual observations in various parts of the Work. Slates form one of the best and most economical coverings; and the cheapest

mode of laying them, is on battens $^3/_4$ in. thick and 2 or $2^1/_2$ in. wide; boarding being of course much more expensive.

Plain (flat) and pantiles (curved with lap) are heavy although durable coverings. Plain tiles are manufactured with two holes through which oak pins are inserted to hang on oak or fir laths.

Pantiles are hung to the laths by a knot formed in making them on the underside nearest the ridge; the surface is both convex and concave. Slabs of stone, naturally very heavy, are used in some parts of the country—particularly in the Weald of Sussex; and oak *shingles* are occasionally adopted. Of metals, copper is one of the earliest ever used for covering roofs, and its elasticity, hardness, malleability, and tenacity are very great. Its lightness is a recommendation as well as its durability and the slight effect produced upon it by atmospheric changes; but its expense has caused it to yield in general use to other metals. The sheets used for roofs weigh about 16 oz. per foot super. Lead is a most valuable metal when exposed, as the atmosphere has little injurious effect upon it. There are two sorts, cast and milled; the latter of which should be preferred for roofs, and weighing from 5 to 8 pounds per foot super. Cast iron painted or galvanized, is often adopted, and the Houses of Parliament are covered with it. Zinc is cheaper than this latter, and it is employed in sheets weighing from 14 to 30 oz. per foot super. Although subject to oxidize, the oxide does not scale off as that of iron, but forms a permanent coating, impervious to the action of the atmosphere. Proper attention in laying it must always be paid to the circumstance that its expansion and contraction are greater than those of any other metal, and there should, therefore, be plenty of play in the laps. Notwithstanding the opposition of the rival metal trades, the demand for zinc is rapidly increasing; and when we state that a square of plain tiling weighs about 18 cwt. and of zinc only 1 cwt., some idea may be formed of the saving of timber by the introduction of this material. By the electro-process zinc is applied to cast and wrought iron and also to copper.

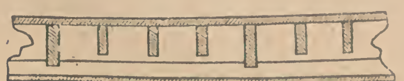
FLOORING.

Naked flooring is the term used to designate the collection of timbers for the support of the flooring boards and ceilings of rooms. *Single flooring, double flooring, double* and *framed flooring*, are the three several kinds in ordinary practice.

In *single flooring* there is but one series of joists, as in the margin, and this, *with the same quantity of timber*, is found practically to be stronger than either double flooring or double framed flooring; but when the bearing is great and it is desirable to keep the surface of the ceiling fair and free from cracks, double floors should be adopted. Of course, it is not always easy to procure long timbers, and a bearing of about 20 feet may be considered a maximum for single joisting.

Whenever the bearing exceeds 8 feet a row of *strutting* should be inserted between the joists and an extra row for every 4 feet of bearing. *Wrought or herring-bone strutting* is generally used.

Where there are chimney, staircase, and other openings, and the joists cannot have a bearing on the wall, a piece of timber, named a *trimmer*, is framed into the two joists, called *trimming joists*, that have a bearing on the wall, and the ends of the intercepted joists are mortised into this trimmer: the whole contrivance being termed *trimming*. It is common to add $^1/_8$ of an inch to the thickness of the trimming joists and trimmers above that of the ordinary joisting for each joist supported. An improvement in common joisting, when it is desirable to have a fair



unbroken ceiling, may be made by having every third or fourth joist deeper and using ceiling joists, as in the wood cut. Such a floor is but a trifle deeper than the common form and, in addition to the ceiling being better, the passage of sound is much impeded.

With respect to the scantlings of joists, those, the width of which is less than half their vertical

thickness, are apt to bend and twist if the strutting above described be not used; for this reason squared timber was very generally employed by the architects of the middle ages. 2 or $2^1/_2$ inches is the least width that should be given to joists, or they will be apt to split when the nails of the flooring boards are driven in. The rule generally adopted for finding the depth of a joist, when the length of bearing and breadth are given, is to divide the square of the length in feet between the supports by the breadth of the joist in inches, and the cube root of the quotient, multiplied by 2.2 for fir, and 2.3 for oak, will give the required result.

The joists should not exceed 14 inches from centre to centre.

In *double flooring* there are three series of timbers called *binding, bridging*, and *ceiling joists*,

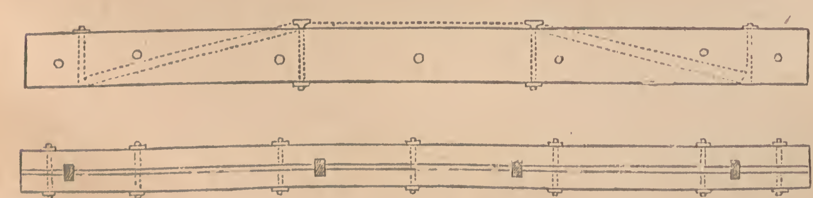
put together as shown in the diagram. The binders are the main timbers, running from wall to wall, and carrying the others. The bridging joists are best notched on to the binders, although they are sometimes framed between with *chased mortices*. The ceiling joists are also best notched on to the underside of the binders and nailed, which is preferable to mortising, weakening as this does the binder, and being also more troublesome than notching. *Pulley mortising* the ceiling joists consists in cutting a chase into the binder, long enough to allow the introduction of the tenons of the ceiling joists obliquely, and they are then driven up. The scantling of the bridging joists is to be calculated by the same formula given for single flooring; and the ceiling joists need not be of greater thickness than is necessary to nail the laths securely to them. They should not thus be less than 2 inches thick, and more than 12 inches apart. The binding joists must not exceed 6 feet apart, and should have a bearing of 6 inches on the walls. The rule for finding the depth of a binding joist, the breadth and the length of bearing being known, is to divide the square of the length in feet by the breadth in inches, and the cube root of the quotient, multiplied by 3.42 for fir, and 3.53 for oak, will give the depth in inches.

When the breadth of a binding joist is desired, the depth and the length of bearing being given, divide the square of the length in feet by the cube of the depth in inches, and multiply the quotient by 40 for fir, and 44 for oak.

In double framed floors there are, in addition to the timbers described in double floors, *Girders*, into which the binders are framed. These girders are placed about 10 feet apart and should

bear on the walls 9 or 12 inches. The passage of sound is effectually prevented in these floors, and from their firmness and solidity the ceilings are excellent.

We need not here repeat what we have previously explained and illustrated respecting the best method of framing the Binders into the Girders.



The diagram in the margin illustrates an ordinary method of trussing girders, when, as is often the case when the bearing exceeds 25 feet, timber cannot be procured of sufficient depth to answer the required purpose; the truss posts and abutment pieces ought to be of wrought iron, and the struts of oak, or any wood stiffer than the girder itself. In this way the bending or sagging of the girder, so apt to push out the wall, is greatly counteracted, and this practice of sawing girders down the middle, reversing them and bolting the two together, has further advantages in allowing a freer passage of air around and permitting an examination into the heart of the wood, whether it is firm and well seasoned or decayed. The method of finding the depth of a girder,

when the length of bearing and the breadth are given, is to square the length in feet and divide the product by the breadth in inches, and the cube root of the quotient, multiplied by 4.2 for fir, or 4.43 for oak, will give the depth in inches.

To ascertain the breadth, when the depth and length are given, divide the square of the length in feet by the cube of the depth in inches; the quotient multiplied by 74 for fir, and 82 for oak, gives the breadth in inches. The weight of a square of double framed flooring varies from 20 to 35 cwt. Subjoined are the scantlings of flooring timbers recommended by Tredgold.

GIRDERS

Bearing	Width	Depth	
10	9″	7″	10 feet apart, 9 to 12 inches bearing on the wall.
12	10″	8″	
14	11″	9″	
16	12″	10″	
18	12″	11″	
20	13″	11″	
22	14″	12″	
24	15″	12″	
26	16″	12″	
28	16″	13″	
30	16″	14″	

BINDERS

Bearing	Width	Depth	
6	6″	4″	4 to 6 feet apart; 4 to 6 inches bearing on the wall.
8	7″	4½″	
10	8″	5″	
12	9″	5½″	
14	10″	6″	
16	11″	6½″	
18	12″	7″	
20	13″	7½″	

JOISTS

Bearing	Width	Depth	
6	2″	6″	Add ⅛″ for each joist supported to thickness of trimmer and trimming joists. Strutting if bearing exceeds 8 feet, and an additional row for every 4 feet. Bearing on walls about 4 inches or more.
8	2½″	7″	
10	2½″	7½″	
12	2½″	8″	
14	2½″	9″	
18	2½″	12″	
20	3″	12″	

CEILING JOISTS

Bearing	Width	Depth	
6	3½″	2″	Notched on to binders, and nailed.
8	4″	2¼″	
10	5″	2½″	
12	6″	2½″	

Floors have often been successfully constructed in novel and extraordinary manners. Rondelet describes one at Amsterdam to a room 60 feet square, consisting only of three thicknesses of inch and a half boards, ploughed and tongued, with two layers laid in opposite directions diagonally

to the sides of the room and the third parallel to the latter, all firmly nailed together and also to strong wall plates, the angles of which are secured with iron straps.

We conclude our notice of flooring timbers with the following general remarks, for which we are indebted to Mr. Gwilt.

"First, the wall plates, that is, the timbers which lie on the walls to receive the ends of the girders or joists, should be sufficiently strong and of sufficient length to throw the weight upon the piers. Secondly, if it can be avoided, girders should not lie with their ends over openings, as doors or windows, but when they do the strength of the wall-plates must be increased. To avoid the occurrence in question, it was formerly very much the practice in this country, and indeed is still partially so, to lay girders obliquely across rooms, so as to avoid openings and chimneys, the latter whereof must always be attended to. Thirdly, wall plates and templets must be proportionately larger as their length and the weight of the floor increases. Their scantlings will, in this respect, vary from $4^1/_2$ by 3 inches up to $7^1/_2$ by 5 inches. Fourthly, the timbers should always be kept rather higher, say half to three quarters of an inch higher, in the middle than at the sides of a room when first framed, so that the natural shrinking and the settlements which occur in all buildings may not ultimately appear after the building is finished. Lastly, when the ends of joists or girders are supported by external walls, whose height is great, the middles of such timbers ought not at first to rest upon any partition wall that does not rise higher than the floor, but a space should, says Vitruvius (lib. 7. C. 1.), be rather less between them, though, when all has settled, they may be brought to a bearing upon it. Neglect of this precaution will induce unequal settlements, and, besides causing the floor to be thrown out of a level, will most probably fracture the corners of the rooms below."

PARTITIONS.

Partitions in carpentry are a species of timber-wall, formed with uprights, posts or quarters, framed and braced together at the top and bottom on heads and sills. When the space between the quarters is filled with brickwork, the partition is termed, *bricknogged*; if constructed of wood only, *a quarter partition.* Partitions are usually plastered: when constructed solely of wood, *lathed* previously. If there is a door in the centre, the principle of a queen-post truss may be applied; if a door at the side, that of the king post truss is suitable. A partition on an upper story under a strongly trussed roof may often be appropriately suspended from it, thus taking off its weight from the flooring.

This latter must be always carefully attended to; for partitions should be so trussed as to rest entirely on the walls, and not be dependent on the joists; they ought in fact to be as much as possible separate structures. About 40^0 is a good angle of inclination for braces; but if the partition has a solid bearing throughout its length, it is preferable without struts or braces, the quarters being steadied by horizontal pieces at intervals between them. The thickness of quarter partitions is usually from 4 to 6 inches, and the weight from 15 to 20 cwt. When the bearing is not above 20 feet, $4'' \times 3''$ will be a sufficient scantling for the posts and, $4'' \times 2^1/_2''$ for quarters. If the bearing is 40 feet the posts may be $6'' \times 4''$, and the quarters $4'' \times 2^1/_2''$; the heads, sills and struts in proportion to the character of the partition and the strains to which they are subjected. Iron tie-rods, heads and shoes are now very generally used in partitions of great size, or exposed to much pressure. It is of the first importance to guard against the shrinkage of timbers in partitions, as, in such instances, the walls and ceilings will be cracked from the settlements which must necessarily take place; partitions should therefore be allowed some time to settle before being lathed for plastering.

DESIGNS FOR TOWN RESIDENCES.

PLATES 67. 68. 69. 70.

These plates contain designs for a row of Town houses of the ordinary description generally in demand in London and other cities and towns. The Elevation forms our first illustration of a continuous connected row of houses, and is designed in the style which appears, judging from what we see around us, to be most popular. The difficulties in planning residences of this description are often great when light cannot be procured at the sides, and almost as much accomodation is demanded as in country houses, where the site is more ample and light can be introduced in every direction. Often, indeed, in London, the kitchen offices in large buildings are placed at the rear in a low structure sometimes only connected by means of a passage with the house, and there is this advantage in such an arrangement that all noise and unpleasant odour arising from the kitchen departments are effectually cut off. The usual plan adopted in smaller dwellings is to have a kitchen in a basement, partly sunk below the level of the ground, a scullery behind this, and various useful closets at the side and under the staircase. An area, approached by steps from the street, is the means of allowing the entrance of a sufficient amount of air and light, and, communicating with this area, vaults under the streets afford convenient cellarage for coals, wine, beer, etc., also water closets, and other conveniences. The ground floor plan has usually a portico leading to a hall or passage on one side of the house, in which the staircase is placed, and which is ordinarily made of the total width of the hall or passage. Beneath the principal staircase, another, best enclosed with a door, leads below to the servants department; and a water closet is, or should be arranged with as much privacy as possible, communicating with the passage. Front and back sitting apartments are usually the only rooms on this level. On the first floor is a drawing room, with the room behind appropriated either as a secondary drawing or bed room. On the upper floors bed and dressing rooms are placed, with water closet, closets for linen, etc. The above will be found an accurate general description of a vast number of houses in London, and, indeed, with the limited site, there is very slight scope for variety in the planning of houses of this description erected continuously, although there is no limit to the variety of character that may be given to the elevations. The design under description presents the features above described and will be found a convenient and desirable residence for its amount of accommodation, which is as follows;—

On the Basement:

Kitchen	16′ „ 0″ × 16′ „ 0″
Scullery	16′ „ 0″ × 12′ „ 0″

Store closet, Pantry, Housemaid's Closet, W. C., and Cellarage.

On the Ground Floor:

Dining Room	16′ „ 0″ × 16′ „ 0″
Breakfast Parlor	16′ „ 0″ × 12′ „ 0″

Portico, Lobbies, Hall, and W. C.

On the first Floor:

Drawing Room	16′ „ 0″ × 16′ „ 0″
Secondary Drawing or Bed Room	16′ „ 4″ × 12′ „ 4″
Ante Room	7′ „ 3″ × 6′ „ 0″

Lobby and W. C.

On the Second Floor and Attic Floor: —

Bed Rooms	16′ „ 0″ × 16′ „ 0″
Do.	10′ „ 4″ × 12′ „ 4″
Dressing Rooms	7′ „ 3″ × 6′ „ 0″
Closets for Linens, etc.	

The height of the Basement is 9′ „ 6″; of the Ground Floor 12′ „ 0; of the First Floor 11′ „ 6″; the Second Floor 10′ „ 6″, and the Attic 7′ „ 0″.

The construction will be as shown on the section, plate 69, which contains also details of the dormer windows. The elevation, plate 68, is proposed to be faced with second malm stocks and cement, and the roof covered with zinc. Details are given on plate 70 of the ground and first floor windows. The expense of a row of six of these houses would be about £ 5,500.

We will resume our general remarks on the fittings of domestic habitations with a few observations on chimneys and chimney pieces, supplementary to the lengthened examination into which we entered on the causes and remedies of smoky chimneys. We gather from an old work, Skirfe's Universal British Builder, the following table proportioning the size of chimney openings to that of the apartments in which they are placed. The consideration, however, of the height of the flue should modify the size of the fire place, which must be proportionately smaller as the flue diminishes in length. There are other circumstances, too, which will modify the dimensions given, but these will readily occur to the readers of the article alluded to.

Side of Rooms	Breadth	Height	Depth
6 feet	1 „ 6	3 „ 0	1 „ 1
9 „	2 „ 0	3 „ 1	1 „ 3
12 „	2 „ 6	3 „ 3	1 „ 5
15 „	3 „ 0	3 „ 4	1 „ 7
18 „	3 „ 6	3 „ 6	1 „ 9
21 „	4 „ 0	3 „ 7	1 „ 10
24 „	4 „ 6	3 „ 9	2 „ 0.

In Morris's lectures on Architecture some rules are stated for proportioning the size of chimney openings to that of the rooms. The first is: — "To find the height of the opening of the chimney from any given magnitude of a room, add the length and height of the room together, and extract the square root of the sum, and half the root will be the height of the chimney." The second is: — "To find the breadth of a chimney from any given magnitude of a room, add the length, breadth, and height of the room together and extract the square root of that sum, and half that root will be the breadth of the chimney." The third rule given is: — "To find the depth of a chimney from any given magnitude, including the breadth and height of the same, add the breadth and height of the chimney together, take one fourth of that sum, and it is the depth of the chimney." The last rule is: — "To find the size of a square or funnel proportioned to clear the smoke from any given depth of the chimney, take three fourths of the given depth, and that sum is the side of the square of the funnel. Observe only, that in cube rooms the height is equal to the breadth, and the foregoing rules are universal." These rules appear to us all very well if the size of the apartment were the only circumstance to be taken into consideration in such calculations. On reference to Sir William Chamber's work on Civil Architecture we find several useful observations on chimneys. — "In the smallest apartments the width of the aperture is never made less than from three feet to three feet six inches; in rooms from twenty to twenty-four feet square, or of equal superficial dimensions it may be four feet wide; in those twenty-five to thirty, from four to four and a half, and in such as exceed these dimensions, the aperture may extend to five or five feet six inches, but should the room be extremely large, as is frequently the case in halls, galleries, and saloons, and one chimney of these last dimensions neither affords sufficient heat to warm the room, nor sufficient space round it for the company, it will be much more convenient

and far handsomer to have two chimney pieces of a moderate size, than a single one exceedingly large, all the parts of which would appear clumsy and disproportioned to the other decorations of the room. The chimney should always be so situated as to be immediately seen by those who enter, that they may not have the persons already in the room, who are generally situated about the fire, to search for. The middle of the side partition wall is the most proper place in halls, saloons and other rooms of passage to which the principal entrances are, commonly, in the middle of the front or of the back wall: but in drawing rooms, dressing rooms, and the like, the middle of the back wall is the best situation, the chimney being then furthest removed from the door of communication. The case is the same with respect to galleries and libraries, whose doors of entrance are generally at one, or at both ends. In bed chambers, the chimney is always placed in the middle of one of the side partition walls, and in closets, or other very small places, it is, to save room, sometimes placed in one corner." Sir William goes on to remark that if two chimneys are introduced into one room, they must be regularly placed, either directly facing one another, or, if in one wall, at equal distances from the centre; and he very properly urges an avoidance of the practice of placing chimney openings in the front wall by the windows. On the decoration of chimney pieces, he gives credit to Inigo Jones, as the first who arrived at any great degree of perfection in this branch of art, it not having been considered with much attention before. "The workmanship of all chimney-pieces," he says, "must be perfectly well finished, like all other objects liable to a close inspection, and the ornaments, figures, and profiles, both in form, proportions, and quantity, must be suited to the other parts of the room, and be allusive to the uses for which it is intended. All nudities and indecent representations must be avoided both in chimney pieces and in every other ornament of apartments to which children, ladies, and other modest grave persons have constant recourse, together with all representations capable of exciting horror, grief, disgust, or any gloomy, unpleasing sensation." Chimney pieces are now to be procured ready manufactured in infinite variety and at a very moderate cost; a plain one of marble may be had for less than £ 2, and others carved with tolerable taste at proportionately low rates. If partycoloured marbles are introduced, there should never be above two or three different sorts of colours in the same chimney piece, and care must be taken that they harmonise well with one another. The effect of these various coloured marbles in friezes, panels, the shafts of the columns, as well as the capitals and bases, is often exceedingly fine and effective.

With respect to the grates placed in chimney openings, Count Rumford, one of the highest authorities, remarks that the great fault in English fire-places arises from their not being sufficiently closed. "The fuel is burnt," he remarks, "in long open grates, called kitchen ranges, over which the pots and kettles are suspended or placed on stands; or fires are made with charcoal in square holes, called stoves, in a solid mass of brickwork and connected with no flue to carry off the smoke; over which holes stew-pans or saucepans are placed on tripods or on bars of iron, exposed on every side to the cold air of the atmosphere." We have given from time to time in the course of this work a number of illustrations of greatly improved forms of stoves, and it is evident that increased attention is now being every day given to the very important object of securing the greatest amount of heat with the least possible consumption of fuel. Rumford recommended, that "each boiler, kettle, and stew-pan should have its separate closed fire-place; each fire-place should have its grate on which the fuel must be placed and its separate ash pit, which must be closed by a door well fitted to its frame and furnished with a register for regulating the quantity of air admitted into the fire-place through the grate. It should also have its separate canal for carrying the smoke into the chimney, which canal should be furnished with a damper or register: by means of this damper and of the ash-pit door register, the rapidity of the combustion of the fuel in the fire-place, and consequently the rapidity of the generation of the heat may be regulated pleasure. The economy of the fuel will depend principally on the

proper management of these two registers." With regard to what are called *smoke-jacks*, Rumford says that no human invention ever came to his knowledge that was so absurd, and yet they are still in very general use.

With respect to the general proportions of rooms, their ceilings and decorations, there should be a general harmony between the exterior and the interior of a mansion; not the interior in one style and the exterior in another. The construction also should be considered with reference to the ornamentation, and even looking glasses may be absurdly placed, giving the appearance of voids, where there are none, and so on.

The proportions of rooms will depend on the purposes to which they are devoted. In England, from motives of economy and warmth, they are generally made too low and are thus often extremely unhealthy, especially where, as is too often the case, no contrivance whatever is adopted to aid their efficient ventilation. It is also the custom to make all the rooms on a floor of the same height without reference to their respective sizes, but the expensive character of a number of different levels will, we fear, effectually preclude much attention being paid to the defect.

Rooms with flat ceilings may be lower than those with coved, and generally all figures, from a square to a sesquilateral, may be employed for the plan. The general rules adopted are, that if the plan be square, the height should not be more than five sixths of the side; if rooms are oblong, their height will be in excellent proportion if it is equal to the width. Coved rooms, however, if square, must be as high as broad; and if oblong, the height may be the same as the width, one fifth, one quarter, or even one third more than the difference between the length and width. Galleries ought to be in height from one and one third of their width to one and three fifths.

In coved ceilings, if the room is low, the cove must be kept also low; if however the room is unduly high, a little extra depth given to the cove will make the fault less evident. The proportions named are approved by Sir William Chambers, who also recommends that when a regular entablature is used to finish a room, it should not exceed one sixth of the height; if only a simple cornice is used, it should not be above one fifteenth or less than one twentieth of the total height. This is all we think we need lay before the reader on these subjects: These general remarks will prevent any very gross violation of harmonious proportions.

DESIGN FOR A GENTLEMAN'S RESIDENCE.

Plates 71. 72. 73.

This is a mansion comprising a very extensive amount of accommodation, the house containing upwards of twenty rooms and offices with three-stall Stable, and Coach house. Plate 71 contains the Front Elevation, Elevation of Stable Building, and the First Floor Plan, which includes seven bed rooms and a bath room. Plate 72 illustrates the Ground Plan, which consists of the principal Building and a wing containing Kitchen Offices, connected with the Coach House and Stabling; over the latter are a Loft and Bed Room. The accommodation includes Drawing, Dining, and Breakfast Rooms, Kitchen, Scullery, Washhouse, Housekeeper and Butler's Rooms, Dairy, Pantry, Store Room, Coal Cellar, etc. Plate 73 contains two Sections illustrating the construction. The probable cost of this House if erected in the environs of London, of bricks and cement with slated roofs and ordinary external finishings, will be **£ 2,200.**

DESIGNS FOR SHOP FRONTS.

Plates 74. 75. 76. 77.

From the many communications with which we have been honoured, we believe that the series of designs for shop fronts with which we now propose to furnish the subscribers will be deemed an acceptable addition to our programme.

That there is very great scope for improvement in this department of architecture few will deny. It is impossible to pace any of our great and fashionable thoroughfares, without remarking the *sameness* of the fronts which meet the eye. The same cornices, pilasters, and consoles are incessantly repeated, and, generally speaking, having seen one, we have seen all. There is certainly a very evident relationship, and it would almost appear as if design were exhausted, or that one proprietor believed it to be almost a heresy to differ from his neighbours.

The tradesman who aims to attract special attention can hardly but be aware of the advantage of individuality. His shop would then be at once singled out from the others, and be speedily recognised at the next visit. We cannot also but think that different styles of architecture would be found of utility as distinguishing the various trades. A linendraper's shop should differ in its external characteristics from a grocer's; and the latter be at once recognised by something other than its inscription and the articles in the windows, from a bookseller's. Now, however, no distinguishing features in decoration represent their appropriation. Such a reform can hardly be expected suddenly and without much study on the part of the architect. A field for appropriate innovation is evidently open, and we propose to submit a series of designs in which we shall endeavour to avoid the more hackneyed types, and aim at an appropriate and, at the same time, economical character of decoration.

A very general defect in shop fronts arises from the excessive aim to obtain an amount of show space inconsistent with an appearance of solidity, and, in fact, endangering the safety of the superstructure. Now, whether the latter be secure or not, it ought to appear so; for nothing is in worse taste than to give a lofty storied house the appearance of resting on plate glass. And it is certain few tradesmen would run the risk of their lives in order to exhibit a few more articles for sale. The use of iron columns should in general be avoided, as a comparatively slight lateral force is sufficient to fracture or unsettle them; and they are generally used of such slight diameters, that we tremble sometimes when we see them. While, therefore, giving the largest possible amount of window space, we shall endeavour to avoid their introduction, and, while preserving that lightness of effect which is so desirable, we shall adhere to what is still more essential, sufficient solidity to support, without any apprehension, the structure above.

The employment of various colours in external decoration is peculiarly appropriate to shop fronts, and will be found a cheap and effectual mode of distinguishing one from another. Cheap, because it costs less than carved decorations, and distinguishing, because brilliant colours more readily catch the eye and produce a more striking effect than any amount of varied surface. We may take occasion to give a few of the more simple rules of harmonious colouring, which will enable the employer to judge for himself of the best means of obtaining the effect he desires, and to avoid that vulgarity too often consequent on trusting to the taste of any painter he may employ.

The ventilation of shops is too often entirely neglected.

Of Butcher's shops we cannot complain; these are generally quite open in front, and in wintry weather, the proprietors can hardly wonder at the ill humour of some of their customers. These.

however, are in one extreme, and they should be contrived so as to admit of being closed more or less. An effort is generally made to ventilate baker's shops, but seldom on any scientific principle. The upper part of the window is perforated for the ostensible purpose of allowing the foul air to escape; but the general effect is, that the vitiated air, which naturally rises, is driven down to be again breathed, causing besides a strong draught on the heads of those nearest the openings. With these exceptions, few shop-keepers trouble themselves about the matter, but we apprehend that, in these days, the majority will be glad of a few suggestions on the subject with the view of rendering the apartment in which so large a portion of their lives is spent as healthy and as comfortable as possible. We shall give a variety of designs, some plain, others decorated, so that from the estimates and the ample descriptions given a selection may be easily made.

DESIGN No. 1.

This and No. 2. are adapted for purposes in which much show space is not required, but the shop windows may be lengthened by adding more bays or divisions. A private entrance is presumed to be essential. The details given and the following descriptions will be found quite sufficient to enable any builder to give accurate estimates of the cost, and to construct the fronts. We shall ourselves give approximate estimates at the end of each description. Localities, the ever varying prices of materials and labour, and the circumstance of whether the shop only is to be built, or the house with it, all impress upon us the duty of apprising the reader that complete accuracy in this respect is totally out of the question. Some builders also, according to the means at their command, can execute works much cheaper than others, and it is rare to find three agree as to anything like a fair total.

Specification of the materials to be used and the mode of constructing and fitting up the front No. 1.

BRICKLAYER.

The piers and half columns to be built with the best hard stock bricks, set in Portland cement, mixed in equal proportions with good clean, sharp, river sand, and used in the work quite fresh. Accurately cut the face to form columns. Turn over the centre and two side openings, arches of three half brick rings, built in cement; the skew backs to be accurately cut, and turn arch under stall board. Form the core for cornice, piers, panelling, etc. of bricks or tiles in cement, cut to suit the contour of the cornice.

MASON.

The two trusses and the caps to the two half columns to be of good sound Caen or other approved stone, free from cracks and vents, and to be carved in a good and artistic manner. Models to be first submitted to the employer.

The sill under shop sashes to be also of Caen stone, weathered, moulded, and rubbed. The core to the cornice to be $2^1/_2$ inch self-faced York stone, both edges coped parallel, and the joints squared and set in cement. The entrances to have Portland steps $12'' \times 4^1/_2''$, with rubbed tops and faces, and back-jointed: the ends cut and pinned into the brickwork.

Fix a Portland curb to the opening under shop front $6'' \times 6''$, tooled on two faces, the joints put together with lead plugs. Let in the ironwork, run the holes with lead, and cut and pin the ends into the brickwork.

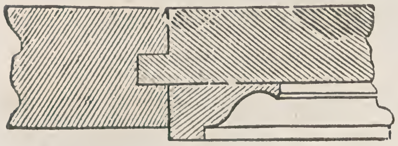
CARPENTER.

Fix over the openings lintels $14'' \times 6''$, lying on the wall 9 inches at each end. The timber to be sound Memel or Dantzic, free from large knots, shakes, or sap.

JOINER.

The frames to the shop-fronts to be deal, wrought, framed. and rebated, $6'' \times 4''$, framed into an oak framed, rebated, and weathered sill $6'' \times 4''$. The circular heads to be put together with

wainscot hammer keys, and to be 6″ × 6″. The half pilasters to be also deal, the size shown, and to be fixed to the frames with coach screws, 4 inches long. The bases to be turned out of deal, fixed into the oak sill and into the ends of the pilasters with wrought iron dowels. The caps to be of Papier-maché. The sashes to be 2 inches thick, faced with moulded brass of an approved pattern, securely screwed to the wood frame, with beads bradded round the inside, and a circular moulding round the outside of heads. The spandrils to be formed by an extra head 6″ × 3″, framed into the circular heads, and a 2 inch back let into a rebate. The ornament to be of Papier-maché. Fix a show-board of inch deal on proper bearers, and bulk head underneath shop sash, and $^3/_4$ inch sloping boarding. The entrance door to shop to be $2^1/_2$″, bolection moulded and bead-flush, the upper panels open for glass, with beads screwed round the glass and made to remove. The door to be hung with $1^1/_2$ pair 5 inch brass butts, and fastened with 6 inch brass latch, with ebony furniture and 2—12 inch bright rod bolts. The door frame to be $4^1/_2$″ × $4^1/_2$″, wrought, framed, rebated, and three times beaded; fixed into floor with wrought iron dowels. Transom $4^1/_2$″ × $4^1/_2$″, wrought, framed, rebated, and four times beaded, and framed through door posts.



Over the transom hang a 2 inch beaded sash, hung on brass sash centres and fastened by brass button. The door to private entrance to be similar, but without open panels and to have a good 12 inch draw back lock and handsome knocker. Each door to have a scraper of good design.

The shutters to be inch $^1/_2$ deal bead-flush and square, the heads cut to fit the circular heads of frames. Each shutter to have stout iron shoes and iron lifts, stubbs, and plates. The whole to be fastened with wrought iron jointed bars $2^1/_2$″ × $^1/_2$″, chamfered at the edges, and strong thumb-screws. The shutters to doors to be inch $^1/_2$ bead-flush and square, with proper plates, shoes, and thumb-screws.

The floor to entrances to be inch $^1/_2$ yellow deal boards, laid on joists, and the steps up to have 2 inch oak rounded nosings and inch tongued risers.

SMITH.

Fill in the space fronting kitchen window with a handsome cast-iron scroll, as drawing, securely fixed into the brickwork and stone curb.

PLASTERER.

The cornice and panelling, columns, piers, and arched opening under stall-board to be executed in the best Portland cement brought up to a good face, all the arrises accurately cut and the cornice to be run from moulds to be submitted to and approved by the employer. The modillions and enrichments to be cast, properly cleaned off, and firmly fixed with spikes. Render, float and set to piers for paper, and white the ceiling in show-space; wrought, rebated, and beaded angle staves at angles.

GLAZIER.

Glaze the sashes and panels of shop door with best British plate glass $^3/_{16}$″ thick, securely sprigged and puttied into frames; the glass to door to be bedded in wash leather.

PAINTER.

Paint or grain the whole of the woodwork, and varnish with two coats of the best copal varnish. The iron work to be painted green and bronzed.

As before said, only approximate estimates can be given. The average cost of No. 1. will be about £ 100. If the sashes are brass an additional expence of about £ 6 may be calculated

SPECIFICATION TO No. 2.

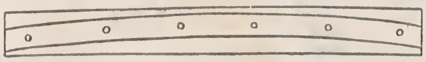
MASON.

Lay over brestsummer a course of 3 inch tooled York stone.

The steps to be of Portland 12″ × 5″, rubbed and moulded on the front-edge and back jointed. Put also to shop entrance a Portland stone landing, 4″ thick, rubbed, cut, and pinned into wall with tiles and cement. York stone templates, 14″ × 14″ and 3″ thick, at each end of and supporting brestsummer.

CARPENTER.

Form a brestsummer over shop, 14″ × 14″, of sound Memel, sawn, reversed and bolted together with 6 — $^3/_4$″ wrought iron bolts, with heads, nuts, and washers complete; and between the two pieces of timber fix a curbed flitch of wrought iron, 6″ × $^3/_4$″, forged in the shape of an arch; the whole bolted together with 6—$^3/_4$″ wrought iron bolts.



JOINER.

The shop sash to be 3 inch, Clark's patent bars, with wrought iron core and hard wood moulding screwed on the inside, a bead bradded round inside, and small rounded fillet outside. Fix a moulded stall board, 9″ × 3″, mitred at angle, and fixed with a wrought iron L plate 1 × $^1/_2$″, let in flush and screwed; the holes for screws countersunk. Inch deal wrought show board on proper bearers. On the inside of show board fix inch $^1/_2$ deal ovolo moulded sliding sashes with frame as shown, with all necessary fillets, beads, etc.

The shop door to be a 2 inch door, bolection moulded raised one side, bead-flush the other; the upper panels open for glass, with moulding screwed round to secure it.

This door to have $1^1/_2$ pair 4″ wrought iron butts, a brass latch with cut glass handle, and two bright rod bolts.

This door to be hung to a wrought, framed, rebated, beaded, and staff beaded frame, 6″ × 6″, grooved for plaster and lining. A wrought, framed, double rebated, double beaded, and double staff beaded transom, filled in above with 2″ moulded light with quadrant corners, hung on brass sash-centres and fastened with brass button. The entrance door to be of similar character, but without open panels and having 12 inch draw-back, brass-mounted lock, barrel chain, and handsome knocker. Scrapers to each entrance of good design. The shutters to be similar to those described to No. 1, modified to suit this front.

Fill in under stall board with inch $^1/_4$ framing, moulded and tongued into stall board, with inch moulded plinth. Similarly fill in under return at shop entrance.

Form the entablature of deal moulding, as drawing, put together in the most secure manner, with tongues, blocks, and screws, and $^3/_4$ cover-board on proper bearers. Inch Honduras frieze, fixed on strong framed cradling, with architrave moulding, the whole housed into wood consoles. The soffite, inside shop and over entrance, to be inch $^1/_4$ deal, moulded and tongued at both edges; fix at angle a $^3/_4$ upright litting, grooved for pannelled lining.

The consoles to be of wood, cut to shape and wrought; the enrichments, both to these and to entablature, to be in Papier-maché, fixed with brads in the securest possible manner. The lining inside entrance to shops to be of a similar character to the soffite. The pilasters to be formed with inch $^1/_4$ moulded panelling and returns, with rebated and mitred angles. Inch moulded plinths and moulded caps, mitred round, the whole securely fixed to strong skeleton framing.

PLUMBER.

Lay the gutter over cornice with 5 lb. lead, overlapping the top member of cornice one inch, with flashing tucked into wall 1 inch and pointed with cement. At one end of gutter, solder an inch pipe to pass through console about 12 inches, and bent down.

GLAZIER.

The shop sashes to be glazed as described to No. 1; the sliding sashes to be glazed with sheet-glass, 21 oz to the foot super, well puttied and back puttied.

PAINTER.

Paint or grain all the wood work of an approved colour; if grained to have two coats of copal varnish. All the work to be thoroughly knotted and primed previous to painting.

The expence of No. 2. will be about £ 80, and brass sashes £ 10 extra. The total sum will include a brass moulded plate to stall board.

SPECIFICATION No. 3.

BRICKLAYER.

Build the piers as shown with stock bricks in cement.

MASON.

Lay over the girder 3 inch tooled York paving. The recess for shop door to be paved with a 4 inch Portland landing, backjointed, rubbed on top, and laid sloping, so as to obviate the necessity of a step.

CARPENTER.

The brestsummer to be of fir, 12″ × 14″, sawn and reversed, with iron flitch as described to No. 2. The inner brestsummer to be similar, 12″ × 12″. Bolt on fir flitch to the upper girder, 12″ × 14″, and also plate below to take ceiling joists, 4″ × 3½″.

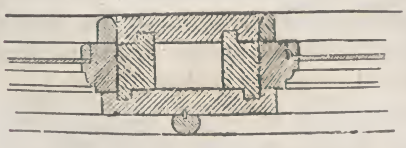
JOINER.

The lower sashes of shop to be formed of brass, with ornamental caps and bases, arched heads and scroll spandrils. The bars to have wrought iron cores and hard wood heads, screwed to the inside. Deal, wrought moulded stall board, 9″ × 4″, and inch wrought show-board on stout bearers. Fill in under stall board with inch ¼ wrought and cross-tongued deal, fixed to stout backings and ¾″ square plinth.

The door to be 2½″ moulded and bead-flush, the upper panels open for glass, with quadrant corners, beads mitred and bradded round glass and made to shift; to be hung with 1½ pair of 4″ brass butts, and 6″ mortice latch, with ornamental furniture and 9 inch rod bolts. The frame to be of deal, wrought, framed, splayed, rebated, and double staff-beaded and grooved for sash bars. Wrought, framed, double rebated, and double staff-beaded transom, with fixed light over, of bars of a similar character to shop front.

The soffite of shop and entrance to be inch ¼ deal, panelled and moulded, staff beaded on edge. The inner brestsummer to be lined with inch wrought, cross-tongued and tongued deal, the soffite and lining to be fixed to strong backings, framed to brestsummer and joists of gallery. Line the inside and returns of piers with ¾″ wrought, matched, and beaded boarding on strong backings, plugged to wall; one board to be hung on hinges and fastened with brass button, so as to get at shutter apparatus.

The upper sashes to be formed as shown, with inch inside and outside linings and large bead on the outside returned above. The inner lining double staff-beaded. Sill 5″ × 3″, wrought and splayed, head and side linings 4″ × 1½″. 2 inch moulded sashes, with bead screwed round to secure glass, and inside beads to fix sash at top and bottom. An under sill to sash 6″ × 3″, wrought and grooved for inch ¼ panelled lining. On the inside fix a ¾″ narrow beaded skirting. Under the plaster cornice fix inch ¼ panelled and moulded lining, fixed to strong backings. The entablatures to have strong moulded cornices put together with glued blockings and screws, ¾ cover boards and blockings, inch Honduras Maho-



gany friezes with architrave mouldings as shown; the whole fixed to strong fir cradling and backings. The modillions to be of deal with papier-maché ornaments. As the iron shutter will not cover the whole of the entrance, fill in the remaining part with inch $^1/_2$ moulded panel, fastened on each side with two 6″ rod bolts. The panel to have a capping to match stall board, and to be accurately fitted.

The gallery to be laid with inch $^1/_4$ yellow deal battens with rounded nosing, inch staff-beaded lining, and soffite with mouldings bradded in.

SMITH.

Fix over upper opening two cast iron girders, coupled together with $^3/_4$″ wrought iron bolts, passing through a wrought iron socket.

The shutters to be Bunnett's or Clark's patent revolving iron shutters; the circumstance of whether or not there is a side or back entrance will modify their arrangement in front.

PLASTERER.

Stucco the brick piers with Roman cement, half sand, half cement, with mouldings, modillions, etc., according to the drawing.

The glazing and painting to be as before described. Nr. 3. will cost at least £ 180, fitted with plate glass in single squares and brass plate on face of stall board.

If zinc is substituted for brass the difference in expense will be but slight, the labour being much about the same.

SPECIFICATION Nr. 4.

BRICKLAYER.

Build the piers in cement and cut the bricks to form the half columns; the core of truss also to be built in cement, cut to the form indicated.

MASON.

Lay over girders a course of 3 inch tooled York paving; and put to door Portland rubbed and moulded step 12″ >< 6″.

CARPENTER AND JOINER.

The shop front to be constructed with fir framed posts 6″ >< 3″ — 3 inch sash, faced with moulded brass, and to have circular corners according to the drawing. Mitre round the inside a head 1 >< $^3/_4$″, and on the outside a rounded fillet 2 >< $^3/_4$″, with ornamental spandrel and eyelet.

Fix on the outside of posts, half shafts, turned out of deal, with turned and moulded bases and papier-maché caps and ornaments; above each column fix a cut bracket as drawing; and between the shafts and wall, tongue a piece of narrow inch lining. Form the return with sash similar to front, with inch staff-beaded and tongued linings. The inner sash to be inch $^1/_2$ ovolo moulded, made to slide in inch $^1/_4$ frame, with all necessary beads, etc., the frame tongued into inch $^1/_4$ beaded linings.

The stall boards to be 9″ >< 4″, moulded and breaking round to form caps to pedestals. Fill in beneath inch $^1/_4$ wrought and cross-tongued deal, beaded round openings, bulk heads over windows and $^3/_4$″ wrought sloping boarding. The pedestals to be inch $^1/_2$ leal, with raised panels and inch moulded plinths. The door to be $2^1/_2$″ moulded and bead flush, with arched heads and beads to form shafts, returned, and papier-maché caps, to be hung with $1^1/_2$ pair 5″ brass butts to linings, with a brass latch, ornamental knob, a good lock, brass mounted, and two 10 inch bright barrel bolts. Frame a double beaded transom, sunk, with papier-maché ornaments, and over transom hang inch $^1/_2$ moulded sash with arched heads, similar to door, but with no caps, and hung on brass sash centres, with brass button.

The shutters to be inch $1/4$ framed, with stop-chamfered panels, and to be fastened and fitted. The soffite under entrance and inside shop to be inch $1/2$ moulded, the sides to have $3/4''$ matched and beaded boarding on strong fir backings.

The floor to entrance to be inch $1/2$ yellow deal on strong joists. The entablature to be formed with strong moulded cornice, put together with blocks and screws, the dentils screwed on. The frieze to be inch $1/4$ sound Honduras, framed in three panels and fixed to strong cradling.

Let architrave mouldings and narrow slip of deal in, and house the ends into consoles.

SMITH.

Girder as before described. Cast iron rails securely fixed under stall board.

The *plumber's*, *plasterer's*, and *glazier's* work to be as previously described. The plate glass to shop sashes to be in two squares with ground edges.

No. 4. will cost on the average £ 90, or £ 95. Brass bars will cost about £ 7 additional.

The extra expense of decorating Nos. 3 and 4 in party colours will not exceed £ 10, and £ 6, over common painting.

DESIGN FOR THREE SHOP FRONTS TO BE ERECTED ON THREE 20 FT. ALLOTMENTS.

Plate 78.

The Design comprises an elevation for three shops, each standing on an allotment of 20 ft. frontage with the ground and first floor plans for one shop. The second floor plan will be the same as that for the first floor, omitting the small bed room. The kitchen, scullery, pantry, cellars, etc., with entrance into the back yard or garden will form the basement.

The ground plan comprises: —

A shop 17 ft. 8 in. by 19 ft. 3 in., communicating with a parlour 10 ft. by 11 ft. 6 in., and a passage with stairs 10 ft. by 5 ft. 9 in., leading to a warehouse or workshop 10 ft. by 10 ft. Under the ground floor staircase are the stairs to the basement.

The first floor plan contains: —

A drawing-room 17 ft. 8 in. by 18 ft., a bed room 10 ft. by 11 ft. 6 in., and a servant's or back bed room 10 ft. by 10 ft.

The second floor plan comprises: —

A front bed room 17 ft. 8 in. by 18 ft.; and a back bed room 11 ft. 6 in. by 10 ft.

The shop and parlour will be 11 ft. high in the clear, and the warehouse or workshop 8 ft.

The drawing room and bed room adjoining will be 10 ft. high from floor to ceiling, and the back bed room 8 ft.

The second floor rooms to be 9 ft. high in the clear.

The cost will be about £ 500 for each shop and residence.

JOINERY.

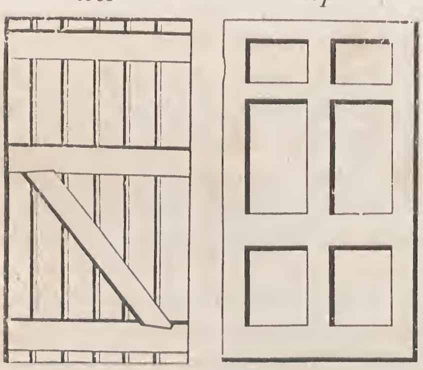
Joinery is the art which has for its object the framing and *joining* together of that portion of the woodwork of houses which constitutes their finishings or fittings, such as floors, staircases, doors, windows, etc. *Carpentry* differs materially from it, being directed almost solely to the consideration of weight and pressure, including, generally, that main framework and those timbers, which come rough from the saw; while the joiner's work requires superior finish, much more accuracy, and is usually brought to a smooth surface by means of *planes*. Carpenter's work, again, is

ordinarily measured by the cubic foot and joiner's by the foot super. The joiner requires much skill in that part of geometrical science which treats of projection, or the method of indicating by *lines* the work to be produced, and he should also have a thorough knowledge of the characteristics of the materials in use. Cabinet making is that department of joinery which is applied to the manufacture of articles of household furniture, and it offers great opportunities in the arrangement of coloured woods, and in the selection of appropriate and tasteful forms.

We have before described the different kinds of wood. Yellow and White Deal, Wainscot, Oak and Mahogany are chiefly adopted by the Joiner. Wainscot should be free from white streaks, which are called "doughty" parts, and indicate decay. If cut in the same direction as the *beat* of the wood, the boards will be variegated and have a handsome appearance; if cut contrary to the beat, it will be uniform. The first method will therefore be best for panels, and the last for stiles and frames, which latter will then be less liable to split, and mortise better. Deals are imported in lengths of from 6 to 14 feet; lengths of 12 feet will generally be found most convenient. Deals, we may also mention, are 9 inches wide, planks 11 inches, and battens 7 inches. For further information on materials, the reader is referred to the article on "The Timber used in Building Operations." We do not deem it essential in this work to make any remarks on the tools used by the joiner, our object being merely to lay before the reader such general observations as, without going deeply into the subject, may be found practically useful.

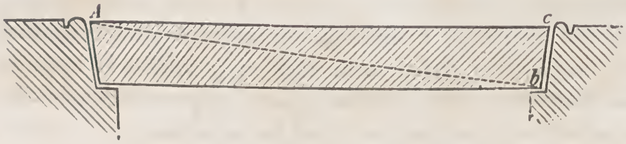
DOORS. Of these there is a very great variety; the most common are *ledged* doors, connected by transverse pieces called *ledges*, sometimes further strengthened by *braces*. The boards are generally beaded, and either *rebated or ploughed and tongued together*. The *stuff*, as the material is termed, is from $^1/_2$ to 3 inches thick. Framed doors are constructed with *panels* framed into side, and centre vertical pieces termed *side and meeting stiles*, and horizontal pieces called *top, bottom, lock, and frieze rails.* The lock is screwed on, or mortised into the lock rail. The panels are either left square on the edge, or finished with mouldings, but sometimes the panels are flush with beaded edges. Doors are classed according to the number of their panels and the mode of finish; thus, there are *two, four, and six panel doors, either square one or both sides, beaded, moulded,* etc. *Sash doors* are what their name implies; *jib doors* are concealed as much as possible, being made continuous with the partition, for the sake of preserving the uniformity of a room; *Folding doors* are double, so as to fold together in openings too wide for a single door. The mortising, tenoning, ploughing, and sticking of the mouldings must be worked correctly to the gauge lines, otherwise much extra trouble will be occasioned. In bead and flush doors, after the work is made square, the panels are first put in and the whole smoothed; the panels are next marked at the parts of the framework to which they agree; the door is then taken to pieces and the beads worked.

toss *top*

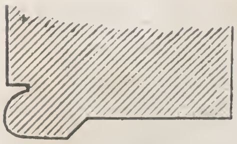


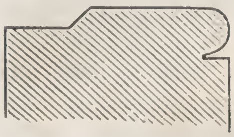
The *hanging* of doors is one of the most important points connected with them; one requiring attention is, that the door should be so hung, that on opening, it may not be possible to see the interior of the room through the joint, which may be accomplished by making it as in the margin, the bead being continued round the door, and a common butt hinge used. The method of finding the proper bevel for the edge of the door, and also for that of a sash, is, by drawing a line from the centre of action *A* to *b*, the inner angle of the rebate, and then drawing *b*, *c*, perpendicular to the

line just obtained, which gives the level. Hinges, generally, should be always so placed that their

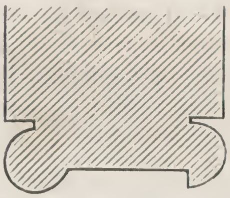


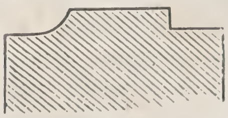
axes may be in the same straight line, as any defect thus will produce a great strain on the hinges every time the hanging part is moved. To hang a door, such as those to pews, so that it shall stand when opened some distance from the jamb, the hinge must project one half the distance required, and the door will describe on opening a part of a circle, the centre of which is the





knuckle of the hinge. — The diagram shows how to construct the joints of door stiles and jambs, so that, when hung together and the door opens at the right angle, a bead shows corresponding with the knuckle of the hinge. The next figure indicates the formation of beads opposite one another and of the same size; only ordinary hinges are required. The clearing of the carpet is a very essential requisite, for the attainment of which the following rules are perhaps the best that can be given. "First, let the floor be raised under the door according to the intended thickness of the carpet; secondly, let the knuckles of the top and bottom hinges be so placed that the top hinge hangs or projects about one eighth of an inch over the lower; that is, if the hinge be let equally into the door, and the jamb project a little beyond the surface of the door; but if the centre lie in



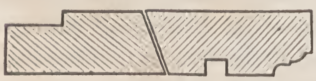


the surface of the door, it must be placed at the very top, which is seldom done, except when the door is hung with centres. Thirdly, let the jamb on which the door hangs, be fixed about one eighth of an inch out of the perpendicular, the upper part inclining towards the opposite jamb; and fourthly, let the inclination of the rebate be such that the door shall, when shut, project at the bottom towards the room about one eighth of an inch." Rising hinges are, we may add, well adapted for the above purpose; those of brass with concealed joints and moulded, burnished knuckles, are excellent, but expensive. Doors, especially folding entrance doors, are often hung on *centres*, fixed at the top and bottom; by reason of the slight degree of friction, these doors often move too easily so as to fall too and vibrate with great force, a defect which may be obviated by the use of a small spring. On the subject of hinges in general, Nicholson remarks, — "The placing of hinges depends entirely on the form of the joint, and as the motion of the door or enclosure is angular, and performed round a fixed line as an axis, the hinge must be so fixed that the motion be not interrupted; thus, if the joint contains the surface of two cylinders, the convex one in motion upon the edges of the closure and sliding upon the concave one, which is at rest upon the fixed body, the motion of the closure must be performed on the axis of the cylinder, which axis must be the centre of the hinges. In this case, whether the aperture be shut or open, the joint will be close; but if the joint be a plane surface, it is nessary to consider upon what side of the aperture the motion is to be performed, as the hinge must be placed on the side of the closure where it revolves. The hinge is made in two parts, movable in any angular direction, the one upon the other. The knuckle of the hinge is a portion contained under a cylindric surface, and is common both to the moving part, and the part which is at rest; the cylinders are indented into each other, and are made hollow to receive a concentric cylindric pin which passes through them, and connects the moving parts together. The axis of the cylindrical pin is called the axis of the hinge. When two or more hinges are placed upon a closure, the axis of the hinges must be in the same straight line. The straight line, in which the axis of the hinges is placed, is called the *line of the hinges*."

WINDOWS AND SHUTTERS. In Plates 4 and 5, Details of Sash and Casement Windows with Lifting and Folding Shutters are given. Plate 4 contains plans, elevations, and sections, and Plate 5 details, some of them full size. They are examples excellently suited for dwelling houses. To windows of such as Nr. 1, the following description will generally apply. Solid fir frames, glued up out of deals $6'' \times 4^1/_2''$, framed, rebated, and beaded. $2^1/_2''$ deal, astragal and hollow French casement sashes, with meeting rails and moulding, as shown, hung folding with $3^1/_2''$ brass butts, the beads to be arched with sunk spandrils; espaniolette bolt fastenings the whole height of casement. Oak sill $5^1/_2'' \times 3''$, wrought and grooved, and this, as well as lower rail of sash, to have patent water-bar, fixed with countersunk screws. Inch $^1/_2$ deal moulded, one panel raised window backs, with tongued and beaded capping, and inch $^1/_2$ moulded jamb linings on splay, and raised marginal panels to soffites. Inch $^1/_4$ proper boxings, $6''$ wide, and moulded architrave $10''$ girt with moulded and splayed plinth, $10''$ high. The front shutters may be inch $^1/_2$ two panel moulded, with raised mouldings on splay prepared to cut; inch bead butt back flaps; the front shutters hung with $3''$ butts, and the flaps with $2''$ flap hinges. Inch two panel, bead butt back linings tongued to frame. Iron spring bow shutter bar, and gilt knobs.

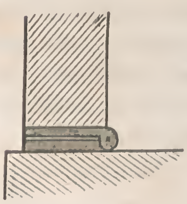
No. 2. may have inch $^1/_2$ ovolo lifting sashes, double hung, with brass axle pullies, patent lines, iron weights, and brass sash fastenings. Inch deal outside and inside linings; inch $^1/_2$ wainscot pulley pieces and parting beads, and $^7/_8''$ inside beads, returned on oak double sunk sill, $3''$ thick; side beads rebated on to pulley stiles. The shutters to be inch $^1/_2$ thick, in two heights, moulded and square, and fixed in similar casing as above, with lines, weights, lifts, and fastening. Inch $^1/_2$ moulded window back, torns moulded plinth $7''$ high, and moulded architrave $8''$ girt; $^3/_4$ rounded flap over shutters, hung on $2''$ brass butts, with flush ring. These descriptions admit, of course, of numerous variations.

Mahogany sashes, whether Honduras, or Spanish, are far preferable to those of deal: they are all moulded in great variety; thus, there are *ovolo*, *lamps-tongue*, *astragal and hollow*, and other forms in common use, besides new varieties daily designed; the thickness of sashes varies from 1, or $1^1/_2$, to $2^1/_2$ inches. The mode in which lifting sashes meet is shown in the margin. In

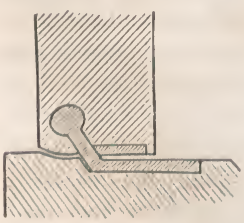


casements, the difficulty is to keep out the wet, which is done most effectually by means of an iron water bar; the method often adopted on the continent is shown on page 137, where will be found further particulars relating to windows and shutters.

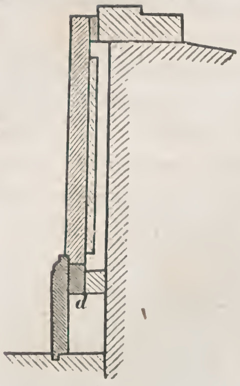
Casements and shutters may also be considered as species of doors, and the hanging of them



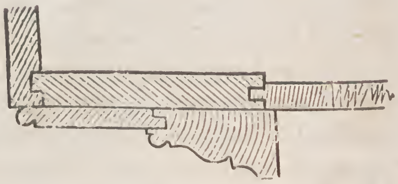
is of equal importance with that of the latter. The annexed diagram exhibits the common mode of hinging shutters, the whole thickness of the hinge being let into that of the shutter, so as to trust as little as possible to the strength of the lining. If it be considered desirable to have the hinge completely concealed, the next cut shows a method of doing so. In framing sashes, shutters, doors, and joiner's work generally, great art is requisite, and the skill of the joiner is tested in so putting together the parts that they may have full liberty to shrink or swell, without necessarily splitting. It is very rarely



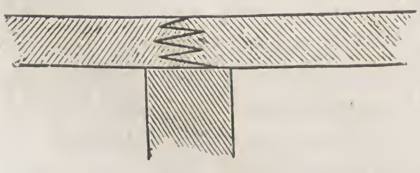
that the stuff is thoroughly seasoned, and it is not a bad practice to put that which is to be used in fine work over an oven for a day or two before framing it; for outside work white lead is used to the joints; for inside work glue. The properly fixing of the work together is of the highest consequence, however well it may have been prepared. We will illustrate the importance of this by some suggestions from the Encyclopædia Britannica appropriate under the present heading. The back of a window having to be fixed, the section shows an excellent method. It is kept straight by a dovetailed key behind it, and, being firmly fixed to the



wood sill, let the narrow piece *d*, with a groove and cross tongue in its upper edge, be fixed to plugs in the wall, the tongue being inserted also into a corresponding groove in the lower edge of the back; it is obvious that the tongue being loose, the back may contract or expand as a loose panel in a frame. The dado of a room may be fixed in a similar manner, and the skirting also *grooved* into the floor, but not fastened to it; the dust is also thus prevented from accumulating behind. All boards above five or six inches wide, should be fixed only at one edge and grooved the other, or fixed in the middle, and the ends left at liberty, otherwise they are sure to split sooner or later. The succeeding diagram illustrates the principle of ploughing and tonguing work together, one of the greatest modern improvements introduced in joinery; the fixing of the *grounds* requires the utmost care and accuracy.



FLOORS. A few remarks on Floors will be found at page 135; we shall here briefly state the several kinds. *Straight joints* are those which are so laid, that the edges of the boards lie in a continuous line throughout their length; each board is laid down and nailed in succession, being previously forced against the last one with what is called a *flooring cramp*. *Folding floors* are formed by fixing every fifth board rather closer than the space occupied by the remaining four, and these, naturally rising like an arch, are forced down by the workmen jumping upon them, and they are then fixed with brads. The boards are thus never exactly accurately laid and soundly fixed to the joists, and this mode should only be adopted with defective and unseasoned stuff, which may be expected to shrink or warp. Battens, 5″ wide, form the best floors, although deals fully 9″ wide are commonly used; when of this latter breadth, the joists are very liable to open, as, of course, the narrower the stuff the greater is the distribution of the shrinkage. The headings to the boards are *square, splayed, ploughed and tongued, rabbeted and filleted, feather tongued, tongued with hoop iron, etc.*, the order of the above being that of the increasing expense. The best floors are planed to a thickness after fixing. The thickness of the boards varies from $^3/_4$ to 2 inches. The joints may be nailed or bradded at the edges, left square, or rebated, ploughed and tongued, or dovetailed; they may be nailed at both, or only one edge, when the joints are plain and square without dowels. Dowelled floors also may be nailed either on one only, or on both sides, but in superior work, the outer edge only is nailed by driving the nail obliquely through the edge of the board, and thus the surface, not being touched, does not show the mode of fixing. Dowelling is superior to ploughing and tonguing on account of the weakening of the edges by cutting away the stuff. The dowels should be placed over the middle of the interjoint in preference to over the joints, in order that the edge of one board may be prevented passing the other. In bradding on one edge, the brads should be concealed by driving them in a slanting direction, through the outer edge of every successive board. A method of forming a tongued joint is shown in the margin, also a mode of forking together the ends of oak boards.



The joists for flooring should be rendered perfectly level by *firring up* previous to laying the boarding, which may be done as soon as the windows are fixed. The edges of the boards must be first shot and squared.

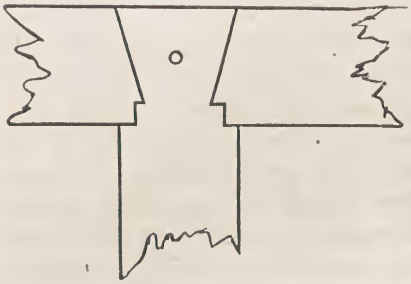
and the opposite edges brought uniform by running a flooring gauge along them, and they are next reduced to a thickness of the common gauge. The advice of Evelyn should be followed as often as possible, namely, to *tack* the boards down only the first year, and nail them for good the next, when they are more completely seasoned, and warping and shrinkage is not so likely to take place.

STAIRCASES. The different descriptions of staircases are described at page 158. The construction of them, and the formation of handrails are, perhaps, the highest effort of the joiner's skill, but our limits do not permit us to do more than just glance at the subject. As the object of stairs is to afford a safe and convenient mode of communication between different levels, their strength should be apparent as well as actual; that there may be a perfect feeling of security. The treads and risers should be properly proportioned; there should be convenient landings, as few winding steps as possible, and railings of sufficient strength and height. On the proportioning of steps we have before spoken; their width may be 3 to 4 feet, and if the breadth is 12 inches, the height may be $5^1/_2$ inches: the breadth should not be, generally, more than 15 inches nor less than 9 inches; the height not more than 7 nor less than 5 inches. Plate 19 contains some illustrations of staircases; the story rod for determining the number of risers is shown on Fig. 1. Having fixed the number of steps, take the rod, mark the height on it from floor to floor, and divide it according to the number of the risers; each riser must be tested as the work progresses, as any little error will increase proportionately in rising; if there be not a level surface to work from, the best plan will be to lay two rods on boards, and level their top surface to that of the floor; then one of these rods is to be placed a little within the string, and the other near the wall, so that it may be at right angles to the starting line of the first riser, or parallel to the plan of the string; then setting off the breadth of the steps on those rods and numbering the risers, we get not only the breadth of the flyers but that of the winders also. To try the story rod accurately to its vertical situation, mark the same distances of the risers upon the top edges, as the distances of the plan of the string board and the rods are from each other. Fig. 1. shows an ordinary wood dog-legged staircase. The letters refer to the method of drawing the upper and lower ramp of the handrail. In the upper one, carry on the line of the straight part of the top of the rail to C and let fall a perpendicular from B, cutting the continuation of E at D, and make $D\ E$ equal to $D\ B$; draw the line $E\ C$ at right angles to the rail E, and then from C as a centre, describe the arc $E\ B$ with the contrary curve. The construction of handrails is so complicated and extensive a subject, that we should require a volume properly to consider it. The *falling mould* has been clearly defined as a parallel piece of thin wood applied and bent to the side of the rail piece, for the purpose of drawing the back and lower surface, which should be so formed, that every level straight line, described to the axis of the well-hole from every point of the side of the rail formed by the edges of the falling mould, coincide with the surface. The *face mould* applies to the two faces of the plank, and is regulated by a line drawn on its edge, which line is vertical when the plank is elevated to its intended position. The *pitch-board* is a right angled triangular board, made to coincide with the rise and tread of the step, one side forming the right angle of the width of the head, and the other of the height of the riser. Handrails are constructed of Deal and Mahogany; veneered handrails are now very much used.

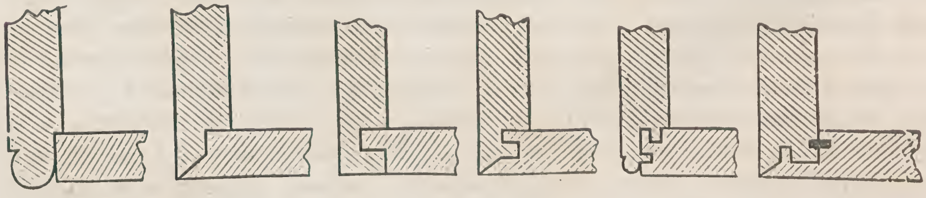
FRAMING. We shall next offer a few observations on *framing* and some of the minor operations of joinery.

Frames are usually connected with mortise and tenon joints, with groves to receive panels. The object to be kept in view is, to reduce the wood to narrow pieces, so that the shrinkage and swelling may be more distributed, and thus enable us in addition to vary the surface without much labour. Panels, for the above reasons, should not be more than 15 inches wide and 4 feet long, and even such large ones as these should be avoided. — The width of framing is usually $^1/_3$ the with of the panels; the latter should fit the groove without rattling, and yet be allowed

to shrink without the chance of splitting, etc. Panels may be $^1/_3$ the thickness of the style, and grooves across the grain $^1/_5$ or $^1/_6$ the thickness of the stuff; otherwise they should not exceed $^1/_3$, often $^1/_4$ is sufficient. —

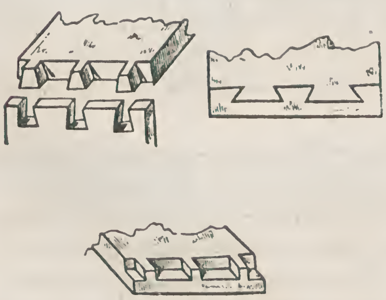


A form of *mortising* is shown in the margin; the oak pin is sometimes used as an additional security. "It is of the utmost importance in framing, that the tenons and mortises should be truly made. After a mortise has been made with the mortise chisel, it should be rendered perfectly even with a float, an instrument, which differs from a single cut, or float file, only by having larger teeth. — An inexperienced workman often makes his work fit too tight in one place, and too easy in another; hence the mortise is split by driving the parts together, and the work is never firm; whereas, if the tenon fill the mortise equally, without using any considerable force in driving the work together, it is found to be firm and sound. The thickness of tenons should be about one fourth that of the framing, and the width of a tenon should never exceed about five times its thickness, otherwise, in wedging, the tenon will become bent and bulge out of the sides of the mortise. If the rail be wide, two mortises should be made, with a space of solid wood between. In thick framing, the strength and firmness of the joint is much increased by putting a cross or feather tongue in, on each side of the tenon; these tongues are about an inch in length, and are easily put in with a plough proper for such purposes. Sometimes, in thick framing, a double tenon in the thickness is made; but we give the preference to a single one when tongues are put in the shoulders, as we have described; because a strong tenon is better than two weak ones, and there is less difficulty in fitting one than two."



Some modes of framing together wood at angles are shown in the margin. They are suitable for skirtings, dados, troughs, fascias; brads may be driven in to secure the angles.

The next diagram shows some forms of joints in the length of the stuff. When it is necessary to join several boards together to form a flat surface, they are often fixed by two pieces, one across each end, with a tongue, or groove, or mortise, or tenon; the cross piece is called a *clamp*, and the whole operation *clamping;* if the ends of the rail are mitred the piece is said to be *mitre clamped.*



Scribing is drawing the exact profile of an irregular surface to be fitted, which is done with a pair of compasses, one leg traversing the irregular surface, and the other describing a line parallel thereto along the edge of the stuff to be cut. — *Dovetailing* is indenting boards together in the manner shown in the margin; the second cut shows a mode adopted for drawer fronts; the third is termed *secret dovetailing.* Concealed dovetailing is useful when the faces

of the boards form a salient angle; when the faces form a re-entrant angle, common dovetailing is best. Lap dovetailing conceals the dovetail, but shows the thickness of the lap on the return side. Mitre dovetailing conceals the dovetail and shows only a mitre on the edge of the planes at the surface of the concourse.

Of mouldings used in joinery there are a very great variety. Thus the edge of a board may be *simply rounded,* or a single or double groove may be made in addition, producing *the single or double quirked bead.* The straight planes which separate mouldings are called *fillets;* the *torus, cima recta, cima reversa, ogee, ovolo, quarter round, and cavetto* are some of those generally used. Mouldings which advance before the face of the framing are termed *bolection mouldings.* In a previous portion of the Work, Page 78, some woodcuts of mouldings will be found.

We have not space to enter into the various modes *glueing up* work. The older the animal from whose skin the glue is made the better it is; that which is produced from the sinews is the worst, and from whole skins the best. The best glue appears of a dark colour free from black or cloudy spots; it swells greatly without melting after three or four days immersion in cold water, and becomes after drying the same as before. Carpenters break glue and soak it for about 24 hours before melting it, and it is warmed afterwards when required. We may remark in conclusion that glued boards will not set in a freezing temperature, the evaporation of the superfluous matter being prevented.

DESIGN FOR A PUBLIC SCHOOL AND RESIDENCE.

Plates 79. 80.

This Design comprises a School Room 39 >< 20 feet, exclusive of recess. The Master's or Mistress's Residence attached to it, the whole forming one connected edifice, has a Parlour, Kitchen, Pantry, and Coal Cellar on the Ground Floor and three Bed Rooms and Water Closet on the Chamber Plan. The school room is to have an open trussed roof with a belfry above it; it will be heated by means of stoves, or fireplaces if preferable. The building altogether, if erected of stock bricks with cement dressings will cost £ 400. The internal walls of the School room may be rendered, set, and finished with sharp sand to resemble trowelled stucco, coloured stone colour when dry.

DESIGN FOR A TOWN HOUSE.

Plates 81. 82. 83.

This Design forms one of our series of Illustrations of Street Archicture. The Elevation is of some pretension, and is of a Venetian character. The three orders, Doric, Ionic, and Corinthian, one above the other, are combined to form a centre, and the side windows are grouped together in the manner observable at Venice.

The front may be executed in cement or stone work, and the roof covered either with Italian formed zinc or slate slabs, with rounded rolls. The accomodation comprises on the Ground

Floor, Hall, Dining, and Drawing Rooms, Kitchen, Scullery, Larder, W. C., and closets; in the Basement, the Cellars are paved. On each of the three Chamber floors are three rooms appropriated as Bed and Dressing rooms. W. C. and convenient closets. If the front is executed with second malm facing and cement, the roof covered with zinc, and the various fittings of a good and substantial description, the cost of construction will average £ 1,500

We shall conclude our general observations on the finishings of Domestic Habitations with some brief general remarks on the Plasterer's, Painter's, and Plumber's avocations.

To the labours of the Plasterer, our dwellings owe much of their finish and comfort; he smooths the walls, lays the ceilings, and renders them sightly and agreeable. *Sulphate of Lime* or *Gypsum* is the basis of all plaster, and of these *plaster of Paris,* particularly that from Montmartre, is generally considered the best. The fossil stone called gypsum is calcined to a powder and burnt in kilns and afterwards pounded. When used, it is diluted with water, so as to reduce it to a thin paste, and it sets rapidly with a considerable increase of bulk. When plaster of Paris is too expensive, a combination of chalk lime with other ingredients is adopted. This is composed of chalk lime, prepared as common mortar, but slacked with a great deal of water, afterwards evaporated. It is mixed with sand of different degrees of fineness, coarse for the first coats, and finer for the finishing, and bullocks, cows, or calves' hair procured from the tanners; the hair is worked in with a rake, after the sand has been mixed. Batty Langley remarked a prevalent practice in his time with reference to bullock's hair, which may be useful still as a hint to some. "This kind of hair is sold wet by the tanners, at one shilling per bushel heaped, which the crafty workman, after he has dried and threshed it, and thereby caused every bushel to measure full two bushels, retails it at 1*s* 4*d* per bushel and thereby gets 1*s* 8*d* in every bushel, which is 166 per cent profit." The lime and coarse sand, with the addition of hair, as above described, is called *coarse stuff* and is that which is first laid on the walls. What is termed *fine stuff*, is lime in a pure state, at first slacked with a small quantity of water brought to the consistence of cream, and afterwards, without any addition, saturated in water, and placed in a half fluid condition in some receptacle till the water evaporates.

Hair is occasionally incorporated for the sake of strength. If mixed with finely washed sand in the proportion of three fine stuff to one of sand, we have *trowelled or bastard stucco*, capable of receiving paint. *Gauge stuff* is composed generally in the proportion of one fifth plaster of Paris to three fifths of fine stuff, mixed in small quantities so that it may set rapidly. Of course, if plaster of Paris is used alone, it sets immediately and should be employed whenever great expedition is necessary. Lime should always be thoroughly slacked; one of the consequences of its not being so is the appearance of what is called *blisters,* and *cracks,* caused by the unequal contraction of the plastering. We have only space just to glance at the operations in plastering. The first coat on brickwork is called *rendering*; the walls being left rough, in order that the plaster may adhere, instead of being drawn with the trowel. In old walls the mortar is raked out, as for repainting, and the surface of the brickwork is roughened by *stabbing or pricking* it over. The surface is next brushed free from dust, wetted, and the plaster applied in a fluid state with a very coarse bristle brush, and before this coat is dry, another is added. When there are ceilings, and partitions, lathing is the first process. If the underside of the joists is uneven, they must be firred up before the laths are fixed. These are of oak and fir; wrought iron nails are to be used for the former, and cast for the latter. The laths are in 3 to 5 feet lengths and about 1 inch wide; *single laths* are $^1/_4$ inch thick; *lath and half* $^3/_8$ and double $^1/_2$ inch; they are formed by splitting or rending, and none that are very crooked should be used at all. The strongest laths are to be adopted for the ceilings and thinner for partitions, and they should be so laid as to break joint as much as possible. Laths are also classed into *heart and sap* laths; the latter being those chiefly used in plastering, and the former in roofing. *Rendering* is the first

coat on brickwork and *laying* on laths; when the plaster has two coats, or is set in addition, the surface of the first is roughened by sweeping with a broom. *Pricking up* on the first of three coats work is crossing it over with the end of a lath, or scratcher, to form a key for the next coat; coarse stuff, as for rendering and laying, is used. *Lathed and laid, or plaster one coat and set* is two coats work, the first coat being covered, when very dry, with a gauge or mixture of putty and plaster, spread with a smoothing trowel and a flat brush of hog's bristles dipped in water.

Setting, we may mention, is either the second coat upon laying or rendering, or the third coat upon floating, laid on when the latter is half dry. *Lath, float, and set,* or *lath and plaster one coat, float and set* has the first coat *pricked up* to receive the set: Floating is simply reducing the surface to a level plane, and is executed by either the *hand float* for one man, the *quirk float* for angles, or the *Derby* for two men. It requires great care and may be applied either to ceilings or walls. In the set of floated work, about one sixth of plaster of Paris is used to give a close appearance, more rapid set, and render it more adapted to receive the colour or whitewash. The pricking up coat for floated stucco work cannot be too dry, but if the floating be so before the setting coat is laid, there will probably be cracks or peeling off; it is therefore of the utmost consequence that the undercoats should always have sufficient time to dry thoroughly. The best setting for ceilings is composed of plaster and putty with a small portion of white hair, called *guage*; common ceilings have plaster without hair, as to walls set for paper. We may briefly put what we have said as follows. One coat work is *rendering* on brickwork, and laying on laths. Two coat work is *render set* or *lath lay and set.* Three coat work is *render, float, and set* or *lath, lay, float, and set.* Walls for paper are set with fine stuff and sand; ceilings with fine stuff and white hair. Plasterers putty is prepared from unslacked lime. We may here mention *rough casting* as a species of plastering much used as an exterior finishing to cottages and country houses. The wall is first *pricked up* with a coat of common lime and hair, and a similar coating is laid upon it, when the first is dry, as smoothly as possible. The rough cast is composed of fine gravel and lime, and is bespattered with a wooden float over the last coat of plaster, directly it is laid and while yet wet.

Pugging, is very coarse plaster, mixed with chopped hay, between floors to prevent the passage of sound; it is good $1^1/_2$ inches thick on sound boarding. Plaster floors formed with coarse plaster, like that of which Dutch terras is made, are used in some parts of the country. The stone becomes white after burning and is reduced to a fine powder when cold. It is put in a receptacle, water is applied, and it is then stirred and used immediately.

Stucco, as a covering to external walls, has excited a great deal of scientific attention and various very excellent compositions have been invented of late years. It is usually composed of calcareous powder, chalk, and plaster, so amalgamated as to obtain a smooth surface, capable of receiving paint, etc.

Bastard or rough stucco, has more sand and is much coarser than trowelled stucco, and it is not smoothed but is left rough from the *hand float,* a piece of felt being placed on the latter to raise the grit of the sand. A good rough stucco may be made from fine stuff, or chalk lime and clear white sand, in the proportion of 1 to 3 of sand. Much used about London consists of washed Thames sand and ground Dorking lime, 3 to 1, mixed dry and thoroughly incorporated.

The walls are prepared by raking the mortar out of the joints and pricking up the surface, the dust brushed off and the wall well washed. The first coat is *roughing in or rendering,* the second *floating,* the third has a small quantity of hair, but, as before observed, is not hand floated and the trowelling but slightly done.

Trowelled stucco, is worked on a floated surface, which must be perfectly dry before the stucco is laid on. The wooden tool, called the float, is used, and the stucco is well beaten and mixed with clear water. The ground having been prepared and made as level as possible, the stucco is spread in squares of about five feet, sprinkled with water and well rubbed till the surface is

fine and even, and thoroughly hardened. The paint or other finishing is laid after the stucco is quite dry. There are a great many artificial plasters to which the name of "cements" has, curiously enough, been given. Of these we may instance the Parian, and Keen, Martins, and John's "cements." Parian cannot easily be distinguished from Parian marble, so beautiful is the finish given to it. 4 bushels of this cement, mixed with an equal quantity of sand, will cover 10 yards super $^1/_2$ inch thick. Portland cement should be used as a rendering coat to Keen's; it can be painted within a few days of its application. Martin and John's cements are also very good; the former dries in about 24 hours. These cements have all plaster bases prepared in a variety of ways, Keen's being soaked in alum water; Parian, gypsum mixed with borax, etc., etc. The cement for which Mr. Parker obtained a patent in 1796 under the name of Roman cement (the latter word being rightly used) is perhaps as well known as any. It is composed of the septaria nodules of the London clay found in the Isle of Sheppy, and sets, if pure, in five minutes, and under water in one hour. When mixed with sand in the proportions of one half, the setting averages between one and two hours. *Portland* cement is composed of the clay of the Medway, mixed with chalk and ground, desiccated and then burnt. It will admit more sand than Roman cement, becomes harder, and resists the weather much better. Most of the artificial cements owe their power of setting under water to the pressure of a certain proportion of clay, and often pure silex; they are generally produced by over-calcining the hydraulic lime-stone, or mixing clays with trass, rich limes puzzolana, etc.

Scagliola is a distinct species of plaster, invented in Italy and first introduced into England by Holland the architect. It is composed of different earthy colours mixed with plaster of Paris in a trough in a moist state until a particular effect is produced. A plaster ground is prepared and it is laid on this and smoothed and polished until it resembles marble.

We have next to make a few remarks on cornices. They should be made as light as possible, and if they project more than 7 or 8 inches, brackets must be fixed at distances of 11 or 12 inches and laths nailed to them. The moulds for running the cornices are formed of beech wood, about $^1/_4$ inch thick, with the quirks and edges of brass or copper. *Gauged stuff* is generally used, composed of fine stuff, putty, and Plaster of Paris. The composition is sprinkled frequently with water, as the Plaster of Paris causes the putty to set rapidly, and it is thus best to endeavour to finish the lengths at one time. The mitres, breaks, and returns are worked by the hand. *Enrichments* are cast, and fixed either with plaster, or screwed to their recesses. Their material is very various; *carver's compo*, a mixture of glue, resin, and whiting; *papier-mâché*, which has, when sharp impressions are required, a priming of whiting and glue over it; *carton pierre*, with layers of whiting and glue; gutta percha, etc., etc. Carver's compo has this advantage, that not being brittle, ornaments can be easily bent and adjusted. Carton pierre enrichments, although not so sharp as those of plaster of Paris, are so light and can be so securely fixed with screws, as to render them very desirable.

The *salpetreing* of plaster is a very common occurrence. New walls are apt to generate nitrate of potash which effloresces at the surface. It is termed by workmen the *salpetre rot*, and consists of saltpetre, nitrate of soda, and chloride of potassium. The use of sea sand is very likely to cause it, but the subject does not appear to be very clearly understood.

With all our scientific knowledge, Vitruvius, the Roman author, is still as high an authority as any modern author on the subject of plaster and cements, and we almost despair seeing the art of plastering such as to enable us to execute works which may bid fair to endure as long as those which still excite wonder in the Eternal City. The plastering there is still often as free from cracks and defects and as polished as when first applied, although eighteen hundred years have passed away since the artificers finished the work; while ours is oftentimes salpetred, cracked, decayed, or fallen down within a few weeks of its execution.

DESIGNS FOR SEMI-DETACHED FAMILY RESIDENCES.

PLATES 84. 85.

Each house has on the Ground Floor, Drawing and Dining Rooms, Kitchen, Scullery, W. C., Coal Cellar, and Larder, etc., and each of the two upper floors four rooms of a convenient size. The Elevations have a moderate amount of decoration and are proposed to be faced with red bricks and cement. The windows in the principal front are grouped in three divisions, producing a pleasing central effect. The cost for the pair will be about £ 1,700.

DESIGN FOR A PUBLIC DISPENSARY.

PLATES 86. 87.

The first plate containing the Elevation to this design has unfortunately been omitted to be numbered. The accomodation comprises Dispensary, Waiting, Consulting, and Committee Rooms, with Residence comprising every accomodation. The waiting room for women may be easily separated from that of the men, by making the entrance for the former where the Hall now is, shifting the partition wall of the extra room a little to the right, and placing a private entrance for the surgeon at the side. Stock bricks and cement dressings being used, the expence of erection may be set down at £ 1,500.

DESIGN FOR A PAIR OF MODEL COTTAGES.

PLATE 88.

In this design the rooms are all on one level as they will occasionally be preferred by many. In our Essay on the subject of cottages for the labouring classes in a previous portion of the Work, we have explained the advantages and disadvantages of this arrangement, and nothing further need therefore be here said upon it. Each cottage contains what we have urged as the minimum accomodation, viz., a living room, Scullery, and three Bed rooms, besides Coal Cellar, W. C., Larder, and Closets. In the roof a loft or store room may be placed, as there is ample space for it, as well as for a cistern, to supply W. C. A Gothic character is given to the Elevation; stone will be preferable, but the two cottages may be erected of bricks for about £ 250 according to the locality.

DESIGN FOR A COUNTRY HOUSE.

Plates 89. 90.

On the Ground level are Drawing Room, Parlour, Kitchen, Scullery, Dairy, Pantry, and W. C.; and on the upper floor four Bed Rooms, Bath Room and, W. C., all of a good and convenient size. If the walls are built of hammered Kentish rag stones in irregular courses, and the quoins of tooled freestone, with the roofs tiled as shown, the cost will not be under £ 1,000.

DESIGN FOR A PAIR OF VILLA RESIDENCES.

Plate 91.

These residences are of considerable pretension with respect to accomodation and architectural effect. The Kitchen offices are placed on the Basement. On the Ground Floor are the Entrance Halls, Saloons, Drawing and Dining Rooms, Libraries, etc.; on the upper floors are the Bed and other rooms. The two houses are varied in plan, but form one composition in the Elevation. The front can be executed in either stone or cement; if the latter be adopted, the walls are to be completely covered with it, and coursed, to imitate masonry. The expense for the pair will vary according to the character of the internal fittings and the locality. If cement is used as a facing, the cost will not be less than £ 6,000.

DESIGN FOR AN ISOLATED VILLA.

Plates 92. 93.

This will be found a very compact little family residence with an effective inexpensive front, for the general idea of the principal elevation, we are indebted to a design by Mr. Lamb, or, perhaps, more properly speaking, the garden front of Sir Charles Barry's Travellers' Club House. On the Ground floor are Drawing, Dining, and Breakfast Rooms, Kitchen, Scullery, and convenient offices. The first Floor Plan contains four Bed Rooms, Nursery, and Closets; and Attic Rooms are placed above. Red bricks and cement dressings are proposed at a total expense of £ 850.

We will here continue our general observations with some remarks on Painting.

This consists in the application on the surface of building materials of a composition capable of preserving them from decay, preventing the absorption of moisture, and producing a finished and pleasing effect. White lead and linseed oil are chiefly used, together with colouring matters, or *stainers* and *dryers*. White lead is carbonate of lead; linseed oil and *turps*, or spirits of turpentine, are employed to dilute the pigments used as stainers, such as ochre, lamp black, Venetian red, umber, red lead, chrome, etc., etc.; sugar of lead ground in oil, litharge, yellow, white vitriol, etc.,

are used as dryers. Painter's putty is composed of linseed oil and whiting well beaten together. Various fancy colours are used, such as drabs, lilac, French greys, blues, vermilion, etc. *Graining* is the imitation of wood, and *copal* varnish is commonly adopted. In ordinary painting, the surface is prepared by sand paper or pumice stone, filling up inequalities with putty, etc. The knots which contain turpentine, are *killed* or burnt out with fresh slacked lime laid on with a stopping knife. It is scraped off after twenty four hours and painted over with size knotting, consisting of red and white lead with double glue size, and gone over a second time with red and white lead and linseed oil. It is then rubbed smooth with a pumice stone. The priming colour is of white and red lead diluted thin with linseed oil. The first coat after the priming consists of linseed oil and a small proportion of turpentine. The work having dried, the second coat is laid, consisting of linseed oil and turpentine in equal quantities. The knots are covered with silver leaf, laid on with japanned gold size, if they show through the second coat and if the work is not intended to be finished white, the second coat must approach the real colour. Before laying the third coat, the work should be stopped with putty where essential, and rubbed down with sand paper. The third coat consists of a base of white lead, mixed with the colour and linseed oil and turpentine in about equal proportions. This is sometimes the last colour; if there are four, the last should be of old white lead, thinned with bleached linseed oil and spirits of turpentine. For a dead white finish, the best old lead is thinned wholly with spirits of turpentine. The work as above is *knotted, primed, and painted four oils.* To paint stucco properly, often five coats are necessary, but if the plaster be not very absorbent, four will be sufficient. The last coat is mixed with turpentine only, and is called *flatting,* the surface being without gloss; if the work be not flatted, the finishing coat has two parts of turpentine to one of oil. The priming coat is boiled linseed oil, then three coats of white lead and oil before flatting. The colour is used some shades darker than the finishing coat; the dryer is sugar of lead. The surface of the plaster must be perfectly dry, otherwise *distemper* colouring is best as a temporary covering, and is much used for ceilings. Two coats of paint are applied and then the distemper, whiting being the basis in a liquid medium of size. Sometimes white lead, ground in water and diluted with parings of white leather and parchment, is adopted.

Clear coling, is often used for repainting old work, from the ease with which a good face can be obtained. In it, size is substituted for oil in the priming coat of white lead ground with water. It has no body, scales off, and the colour changes in damp situations. It should never be employed except when the work is greasy.

Fresco, is painting on walls while the plaster is still wet, and requires great rapidity of execution and considerable care, as the work cannot be altered. In graining, there is considerable scope for skill and taste; in Paris it is much more common than here, and the dead white of our houses is comparatively unknown there. Four or five coats having been laid, the last is composed of equal parts of oil and turpentine, and the shades and grain of the wood are produced by means of thin glazings of Terra de Sienna, Vandyke brown, or amber. It is afterwards varnished with copal. *Lettering* is practised as a distinct trade. The words are sketched in pencil and the outline corrected in colour. If gilt, they are covered with leaf gold while the paint is yet wet, a sponge clears away the superfluous gold, and the whole is varnished. Letter writing is charged by the inch.

For repainting old work, white lead, mixed with a small portion of red lead and equal parts of oil and turpentine, is called *second colouring old work.* A mixture of old white lead and blue black in a medium of half bleached oil and half turpentine is adopted for finishing. For outside work, turpentine, as more susceptible of water than oil, should not be used. Puttying is be stafter the first coat of paint, on account of its then adhering firmer. In varnishing, currents of cold or damp air must be avoided, by reason of their injurious effect. To iron work, the priming coat should be always of oil, the rust and corrosion being carefully cleaned off. Two coats in red

lead paint are good. If the priming to paper and canvas is of oil, they will rot; it should be always of size.

On the important necessity of cleanliness to the painter we hardly need insist. His occupation, consisting in the constant use of white lead, is essentially unhealthy. Paralysis, painter's cholic and a slow course of poisoning is, with little exaggeration, the painter's unhappy fate. Of late years the use of the oxide of zinc as a substitute for white lead has been extensively introduced in this country by the Vieille Montagne Zinc Company. The French Government has enforced its use in all public works. The smell of the turpentine is the only inconvenience that is felt, and even hospital wards may be painted with it without prejudice to the health of the inmates. It takes a longer time to harden than white lead paint; the *patent dryers* are objectionable as containing lead, and the zinc will not combine with oil to form a plaster, as the oxide of lead. Notwithstanding all this and that the covering properties have been questioned, white zinc paint presents so many great advantages, that we cannot doubt its extensive adoption, and an inferiority of ultimate cost of about 10 per cent may be calculated.

DESIGN FOR AN ITALIAN VILLA.

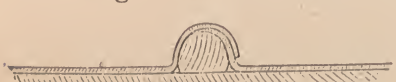
PLATES 94. 95 96.

This is an extensive and convenient residence of some external pretension. The treatment adopted is of an Italian character; the tower is a prominent feature, but, as will be perceived, it is not a mere adjunct, but forms an intimate portion of the mansion itself. In the decoration, the effects are obtained chiefly by the contrasting of flat surfaces, expensive mouldings and carving being avoided. The roofs are to be covered with zinc, and the means adopted for ventilation are treated as ornamental features. A Terrace in the principal front opens into a spacious Hall, with Drawing and Dining rooms on either side, with large bay windows. There is an Inner Hall communicating with the Breakfast Parlor or Library at the side of the house and with the Conservatory; a door also leads from both halls into the passage to the Kitchen Offices and Cellars. The lobby under the stairs will be found convenient to the servants going from the Kitchen to the Dining Room. The Kitchen is spacious and well lighted and communicates with a Scullery beyond it. Larder, Store, Housemaid's, and two Water Closets are provided. A Staircase leads from the Kitchen passage to the Cellarage. The First Floor has also a Terrace opening out of the capacious landing of the Staircase. The suite of Bed and Dressing Rooms, Boudoir, and W. C. appropriated to the proprietor and his lady, are separated by a door, leading into their passage from the other portion of the house. A desirable privacy is thus obtained, and the windows of these rooms command views on three sides of the house. Two Bed Rooms and one Dressing Room are also placed on this floor, besides an extra W. C. and large Closet. The floor above may be divided as convenient; there is space for six Bed Rooms, besides Closets. By carrying up the story shown at the rear of the Principal Elevation, two bed rooms for servants may be added. The appartment in the upper part of the Tower may be appropriated as a Prospect or Smoking Room; a small narrow staircase, cutting off a portion of the Bed room below, is to be arranged to lead into it. The curved roof is a comparative novelty in this country, and the lantern above will serve the purpose of ventilating the smoking room. If the house is faced with second malms and cement, the total cost will average £ 3,000.

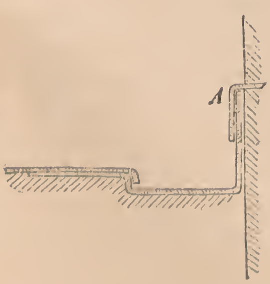
We shall here resume our general observations with some remarks on the Plumber's art.

Lead is of a bluish white color, when nearly melted quite bright, but tarnishing rapidly. Its ductility is considerable, but a leaden wire 120th part of an inch in diameter will not support above 3 lbs. Next to tin, it is the most fusible of metals; if cooled slowly it crystallizes. It combines with oxygen, which converts its external surface into an oxide and alters its colour. Water takes some time to act upon it, but considerably hastens the process of oxidation, observable in the production of a white crust. It is only lately that the poisonous effects of lead used to convey liquids has excited much attention, but not half so much as should be given to the subject; in France the use of lead pipes to convey beer and wine has been recently very properly prohibited by the Imperial government. "They order this matter better in France," as Lawrence Sterne would have said. Tinning the lead pipes within is one remedial method practised.

Lead is purchased by plumbers in *pigs*, and they reduce these into sheets and pipes as they are required. Sheets are of two descriptions, *cast* and *milled*. The cast is used for flat roofs, gutters, reservoirs, etc., and varies from 5 to 8 per lbs. in weight per foot super. Deception is often practised by using a lighter weight than that ordered, and attention should be paid to this circumstance. The cast lead is usually formed by plumbers from pigs of old lead taken in exchange; these are rolled up and charged for by the weight. Milled lead is purchased of the lead merchant; it is cast and prepared at the ore and wasting furnace. It is usually thin, commonly not more than 4 lbs. to the foot super, and is adapted to the hips and ridges of roofs. In gutters, terraces, and parts much exposed to the sun and wear and tear, it is soon worn away, expands and cracks. A laminating roller is employed to reduce it to an even state. The laying of lead requires care and attention. The sheets do not exceed 6 feet in breadth, if cast, 16 to 18 feet long, if milled 25 feet. The joints in flats are formed with laps or rolls. The rolls are made as in the margin, one edge of a sheet being dressed over the roll on the inside, and the other over them both on the outside. No fastening is essential, the sheets being merely well hammered together. *Seams* are defective substitute for rolls; the edges of the sheets being bent up over against one another and dressed down throughout their length close to the flat. Solder is sometimes applied to these, but its use is extremely objectionable, inasmuch as one of the first principles in laying lead is that it should be left perfectly free to expand or contract, otherwise damage will sooner or later occur in the shape of cracks, dilapidation and leaks.



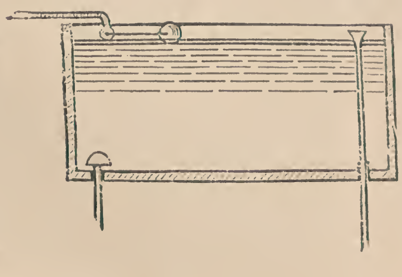
The general rules with respect to solder are that it should always be easier of fusion than the metal to be soldered and of the same colour. The *soft solder* (that most used) is composed of tin and lead in equal parts and melts very easily; it is sold by the pound. The *current* or *fall* of flats should be about 3 inches to 10 feet, to gutters 2 inches; the *drips* 2 inches deep and 10 feet apart; and the lead is dressed up the brickwork at the sides about 6 inches, and let 2 inches into it. For *flashings* milled lead should be employed, about 5 lbs. to the foot and 8 or 9 inches wide. They are placed as in the margin, the mortar being raked out of the joint; sometimes they are fastened with wall hooks and the lower edges dressed down, and sometimes pointed in cement. For drips the lead is dressed in a somewhat similar manner to that of the rolls. *Step flashing* is often used to gables; the lead is cut so as to form as it were a series of steps instead of being continuous. 6 lbs. lead may be used for flats; 7 lbs. for gutters, and 5 lbs. milled lead for flashings, hips, and ridges; 4″ socket pipes out of 10 lbs. lead are used to lead from cesspools, 6″ deep, into the heads of the rain water pipes. Hemispherical *roses*, 6″ diameter, pierced with holes out of 10 lbs. lead are also used, and sometimes iron or zinc gratings. 3 feet is a good *length* for sheets, to allow



a sufficient play to the metal. We may here caution our readers against a certain practice of some plumbers, viz., that of charging for sheet lead and labour at so much per cwt., for piping at so much per foot, for the joints in piping and labour and solder used in making them, and then *winding up the account* with a separate charge for solder and labour, appearing to the uninitiated very fair, but in point of fact, charging twice over. As "the custom of the trade," and a very disreputable custom it is, these charges have actually been sanctioned by learned judges. We mention the matter, but, as is remarked in the Encyclopædia Britannica, "the now prevalent custom of artificers work being done by general builders by tender and contract has considerably lessened the injury to the public from this abuse, and proved it to be really so by the moderate profits the same men will content themselves with, if they make a tender, who would persist in charging at the old rate if they were instructed to do the work without being bound by contract." Lead pipes were formerly made of sheet lead, wrapped round an iron or wood cylinder, of the length required, and then soldering the edges. Casting them was next adopted in iron moulds in two halves forming, when together, a cylinder the size of the pipes. The method now in general use is to cast the pipes first, and the lead, being in short lengths three or four times the thickness of the intended pipes, is next *drawn* through holes in pieces of steel, as in wire drawing, till the piping is of the required thickness and length. There are many variations of the details of the operation, but we have not space to enter into them, and content ourselves with presenting the following table of the weight of lead piping.

3/4 inch	. . . . .	per yard	10	lbs.
1 "	. . . . .	"	12	"
1 1/4 "	. . . . .	"	16	"
1 1/2 "	. . . . .	"	18	"
1 3/4 "	. . . . .	"	21	"
2 "	. . . . .	"	24	"

Pipes have various names according to the uses, to which they are appropriated, thus there are *service* or *supply*, *drip* or *soil*, *rising*, *main*, *warning*, *waste*, pipes, etc., and there are an infinite variety of joints, fittings, ferrules, bosses, washers, cocks etc., an inspection in a plumber's shop conveying a far more intelligible idea of them than any description. Water closets are fitted up by the plumber. A great number of fittings have at different times been patented for them, the general principle consisting in the placing of a cistern over-head, which, by means of a lever attached to a valve in the cistern, allows a portion of the water to descend, wash the basin and clear the soil pipe and drain, the actions being almost simultaneous. The contrivance is one peculiar to modern times, and a most admirable sanitary arrangement it is. The cost of the closet apparatus varies from £ 1 to £ 4, according to the completeness of character and the materials of the whole. The cisterns are lined with lead, 7 or 8 lbs. to the bottom and 6 lbs. to the sides, turning over the top edges 1 1/2 inch, and nailed. They are supplied by *main service pipes*, the flow of water being regulated by a *ball cock*, open and shut by a lever, with a copper ball at the end, floating on the surface of the water. As the cistern fills, the ball of course rises, and when the lever is horizontal, the cock is quite closed and prevents more water entering the cistern. A *waste pipe* of sufficient diameter to draw off rapidly the water is inserted in the bottom of the cistern; a standing waste pipe is screwed on to this, the junction consisting of a brass plug and washer, and rises to very near the top of the cistern, with a *trumpet mouth*, so as to carry off the water, when, owing to the ball-cock being out of order, it continues flowing. The pipes, conveying the water to different parts of the house, are placed about



an inch from the bottom of the cistern, *above the sediment*, with what is termed a *rose* over them, to prevent the entrance of the latter. When cisterns are supplied from pumps, an $^1/_2$ inch *warning pipe* is led back to the pump to indicate when the cistern is filled; the standing waste should be still retained. It will be perceived from the above description, that a cistern is a very complicated apparatus, extremely liable to get out of order, occupying much space, costing much money, giving great trouble, and altogether a great nuisance. So long however as water is supplied on an absurd intermittent instead of a constant system, cisterns, with all their paraphernalia of pipes, cocks and scrubbings, will still continue to cause vexation. The superiority of the constant system of water supply over the intermittent cannot admit of a doubt. With respect to economy alone, Mr. Dempsey states, — "It is found at Nottingham, that one experienced man and one lad are sufficient to manage the distribution of the supply to about 8,000 tenements, and keep all the distributory works, including cocks, main, and service pipes, etc., in perfect repair. Under the intermittent supply system, a numerous staff of assistants would be required to discharge similar duties." By the constant service principle, the cost and expense of the cisterns is saved, the sizes of the main and supply pipes may be reduced, as if the water flows only for a short time they must be sufficiently large to admit rapidly a certain quantity; from the water flowing constantly the pipes are not liable to burst, as they are, when a sudden rush of water compresses the air within with tremendous force; the water is again not so liable to be frozen, and thus burst the pipes; and their being constantly charged tends to prevent a certain corrosion, which takes place when only occasionally filled with water. Again, with respect to sanitary considerations, the damp necessarily arising from the evaporation of the water in cisterns in dwelling houses is avoided. Fresh water too is much more likely to be obtained, as that at the bottom of the cistern generally remains in a stagnant state, not replaced but added to by the next supply; for efficient cleansing is rarely performed once a month or fortnight, and from imperfect construction and covering, the bottom of the cistern generally contains a layer of soot, mud, and dirt of various composition. Filtering cisterns are perhaps the best remedy; we gave in an earlier number an illustration of one of slate. Sinks, if of wood, are lined with lead; 7 lbs. lead are suitable with 5 lbs. milled apron 9″ wide, nailed over the edges with copper nails. $^3/_4$″ service pipe from the cistern, $^3/_4$ brass bib cock and bosses, 4″ brass grate and bell trap with cross wire guard, and 2″ or 3″ waste pipe delivering into the drain. Suction and forcing pumps are supplied by the plumber, but we need not here enter into their construction and several kinds. A common house pump may be procured for 30 shillings; a brass barrel lift pump for £ 3; Hydraulic pumps from about £ 5; and pump rods in about 10 feet lengths, with joints and brass couplings at £ 1 per foot.

THE STONES USED IN BUILDING OPERATIONS.

Hardness, tenacity, compactness, and a power to resist the decomposition caused by water and the atmosphere, are the chief requisite qualities in stone used for building. It is melancholy to observe in our cities the little judgment that has been displayed in the choice of this material; many stone structures beginning to decay within a short period of their erection. With all our boasted science the people of antiquity displayed far more knowledge in this respect, as is sufficiently evinced by the present condition of their structures. Alterations of temperature, the smoke of cities, rain, and moisture, the action of wind constantly blowing dust on a building, are all operations tending gradually to wear away stonework. It has been truly remarked, that "in modern Europe and particularly in Great Britain, there is scarcely a public building of recent date,

which will be in existence a thousand years hence. Many of the most splendid works of modern architecture are hastening to decay in what may be justly called the very infancy of their existence, if compared with the date of public buildings that remain in Italy, Greece, Egypt, and the East." Disintegration and decomposition are the two main processes of decay. Disintegration is a mechanical operation; water accumulates in the minute pores of the stone, freezes and bursts it, or separates small portions, according as the structure is irregularly granulated, slaty, etc. The south sides of buildings are, in this country, peculiarly liable to fail, because the surface, thawed and covered with wet in the day, when the sun is upon it, is frozen again at night. Water again softens the clayey portions of those stones which are thus cemented together. In all temperate climates where there are great irregularities in the weather stones are sorely tried. A torrent of rain will carry down a building all the dust which has been blown against it, and thus slowly and in the course of years wear it away. Decomposition again effects a chemical change, consisting in the tendency of the stone to absorb oxygen and carbonic acid from the atmosphere, and is by that union dissolved into earthy powder. Thus in granite, the hardest of all rocks, one of its components, felspar, containing saline matter, is subject to decay in proportion as the soluble salt exists. Rain-water always holds in solution carbonic acid, and the power of this in dissolving carbonate of lime is very great, more particulary in the environs of populous cities, where there is a larger proportion of the ingredient; and thus stone buildings in the country are more durable than in towns. The iron, copper, lead, and other metals used in stone work are likewise all liable to the oxidating effects of the water, causing them to enter into new combinations and hasten the decomposition of the stone around.

Sir Humphrey Davy observed: "Amongst the substances employed in buildings, wood, iron, tin, and lead are more liable to decay from the operation of water, than marble when exposed to its influence in the fluid form; brass, copper, granite, sienite, and porphyry are all more durable. But in stones much depends on the peculiar nature of their constituent parts. When the felspar of the granite rocks contains little alkali, or calcareous earth, it is a very permanent stone; but when in granite, porphyry, or sienite, either the felspar contains much alkaline matter, or the mica, schorl, or hornblende much protoxide of iron, the action of water containing oxygen and carbonic acid on the ferruginous elements tends to produce the disintegration of the stone." The stone which is nearest at hand will be generally used on account of the cost of conveyance. We do not propose to enter into the details of quarrying, and will merely remark that the chief points to be observed are the position and quantity of the stone, its hardness, heaviness and general nature, remembering that the deepest is as a general rule more durable than that near the surface, on account of the superincumbent pressure and the consequent density and hardness in proportion as this exists. In selecting stone, its mineral character, chemical composition, cohesion, weight, hardness, brittleness, and absorbent power have all to be taken into consideration and determined in comparison with a settled standard. In order to form a judgment of any building stone which has not had the test of experience, it is desirable to examine it in its native bed, particularly those parts of the bed which have been long exposed to air.

When the examination cannot be made, all stones that are not calcareous may be in some degree proved, by observing what effect is produced upon them by immersing them in water for a given time, by exposing them to a red heat or to frost, or by covering them with dilute acid for several days. Those stones, which absorb the smallest quantity of water, and which are least changed by the action of heat, frosts, or acids, may be fairly considered as most capable of resisting the decomposing or disintegrating effects of moisture and change of temperature. It has recently been the practice to rub the calcareous sand-stones with oil, which thus must to a certain degree resist the absorption of water and contribute to the durability of the stone. Two methods of testing building stone are in general use, one determining the cohesive, the other the absorbent power — the latter a species of imitation of the effects of the weather and extremely valuable.

The resistance of stone to a crushing weight is an important matter, to which too little attention is given. The mediæval architects seem to have attended to it more than the ancient: if we may infer from the superior lightness of their structures, they had arrived at the conclusion, that greater weights might be safely entrusted to a less amount of masonry. The celebrated discussion on the safety of the dome of the Pantheon in Paris is, we believe, the first recorded instance of the institution of a series of experiments on the crushing weights of stones. The mode now usually adopted is to submit small cubes to the pressure of a Bramah press, observing the weight at which it first cracks and then crushes. Of course it will be impossible to get all the stones equal to the one experimented upon, and allowance must therefore be made for those of inferior quality, bad, weak, or cracked; and, as a general rule, it is best not to entrust stones with the support of a greater weight than $^1/_{10}$ of that, which will crush them. The following table is given by Gwilt as the result of experiments to ascertain the crushing force.

	Pounds
Portland stone, 2 inches long, 1 inch high	805
Statuary marble, 1 inch cube	3216
Cragleith stone do	8688
Chalk, cube of $1^1/_2$ inch	1127
Roe stone Gloucestershire, cube of $1^1/_2$ inch	1449
Red brick do.	1817
Portland, called paviors do.	10,284
Yorkshire paving do.	12,856
White statuary marble do.	13,632
Cornish granite do.	14,302
Dundee sandstone do.	14,918
Portland, a 2 inch cube	14,918
Compact limestone	17,354
Porterhead granite	18,636
Purbeck	20,610
Freestone, very hard	21,254
Aberdeen granite, blue kind	24,556

The thickness of walls and piers must be proportioned more with reference to their height than to the weight they are to carry; the crushing of stone by superincumbent pressure being a very rare occurence in buildings; the action of the weather should be chiefly taken into consideration. The determination of the absorbent power becomes therefore an important matter for experiment. Brard's method, frequently adopted, is a chemical process for imitating the disintegrating effects of the weather, and is perhaps the best of any. Before proceeding to describe the particular kinds of stone in use, we will close our general remarks with a valuable extract from the Report of the Commissioners selected to report on the stones of Great Britain, on the occasion of building the New Houses of Parliament, and which presents an able summary of the various causes operating to cause decay. "As regards the sandstones that are usually employed for building purposes, and which are generally composed of either quartz, or silicious grains, cemented by silicious, argillaceous, calcareous or other matter: their decomposition is effected according to the nature of the cementing substance, the grains being comparatively indestructible. With respect to limestones, composed of carbonate of lime, or the carbonate of lime and magnesia, either nearly pure or mixed with variable proportions of foreign matter, their decomposition depends under similar circumstances, upon the mode in which their component parts are aggregated, those, which are most crystalline, being found to be the most durable, while those which partake least of that character suffer most from exposure to atmos-

pheric influences. The varieties of limestones termed Oolites (or Roestones) being composed of oviform bodies, cemented by calcareous matter of varied character, will of necessity suffer unequal decomposition unless such oviform bodies and the cement be equally coherent, and of the same chemical composition. The limestones, which are usually termed *shelly*, from their being formed of broken or perfect fossil shells, cemented by calcareous matter, suffer decomposition in an unequal manner, in consequence of the shells, which, being for the most part crystalline, offer the greatest amount of resistance to the decomposing effects of the atmosphere. Sandstones, from the mode of their formation, are very frequently laminated, more especially when micaceous, the plates of mica being generally deposited in planes parallel to their beds. Hence if such stone be placed in buildings with the planes of lamination in a vertical position, it will decompose in flakes according to the thickness of the laminæ; whereas if it be placed so that the planes of lamination be horizontal, that is, most commonly on its natural bed, the amount of decomposition will be comparatively immaterial. Limestones, such at least as are usually employed for building purposes, are not liable to the kinds of lamination observable in sandstone; nevertheless varieties exist, especially those commonly called *shelly*, which have a coarse laminated structure, generally parallel to the planes of their beds, and therefore the same precautions in placing such stone in buildings, so that the planes of lamination be horizontal, is as necessary as with sandstones above noticed. The chemical action of the atmosphere produces a change in the entire matter of the limestones, and in the cementing substance of the sandstones according to the amount of surface exposed to it. The chemical action due to atmospheric causes occasions either a removal or disruption of the exposed particles, the former by means of powerful winds and driving rains, and the latter by the congelation of water, forced into or absorbed by the external portions of the stone. These effects are reciprocal, chemical action rendering the stone liable to be more easily affected by mechanical action, which latter, by constantly presenting new surfaces, accelerates the disintegrating effects of the former. Buildings in this climate are generally found to suffer the greatest amount of decomposition on their southern, south-western, and western fronts, arising doubtless from the prevalence of winds and rains from these quarters; hence it is desirable that stones of great durability should at least be employed in fronts with such aspects. Buildings situated in the country appear to possess a great advantage over those in populous and smoky towns, owing to lichens, with which they almost invariably become covered in such situations, and which, when firmly established over their entire surface, seem to exercise a protective influence against the ordinary causes of the decomposition of the stone upon which they grow."

This latter circumstance is doubtful in our opinion; for the lichens, insinuating their roots, form a vegetable mould retaining damp, and which can do no particular good, but rather evil.

We will now state very briefly the various kinds of stones and their properties, commencing with a class in general use viz.

LIMESTONES (*calcareous*).

These are a species of freestone, a name applied generally to stones which can be cut with the saw, or wrought with the mallet and chisel. Limestones are composed of the carbonate of lime, or the carbonates of lime and magnesia, either mixed with various proportions of foreign matter, or really pure. Those called *oolites*, or *roestones* are composed of oviform bodies cemented with calcareous matter; the *shelly*, or fossil shells, cemented also by calcareous matter. Indeed, *calcareous* is the general term applied to limestones, including marbles; all limestones which admit of a good polish being called marbles. Their hardness and admission of polish is owing to the simple alteration of the carbiniferous limestones by metamorphic action. *Magnesian limestones* consist of almost equal parts of carbonate of magnesia, and carbonate of lime, of crystalline

texture and in a state of perfect combination with a pleasing colour and pearly lustre. The oolites, an early geological formation, are the limestones chiefly adopted in building. Limestones have been used from time immemorial. The Pyramids of Egypt are erected of a greyish white calcareous stone; the Greeks used various marbles; at Constantinople a fine grained limestone, now used for lithography, is adopted; the whitish, porous limestone, called *travertino*, is the material of the Coloseum, St. Peter's, and other edifices in Rome, also of the temples of Pæstum; the edifices of Paris are of limestone, and our own St. Paul's is of oolite. Portland is very commonly used in London. Its hardness gives it many requisites to produce very fine masonry; it is strong and heavy, and of a whitish brown and greyish white colour; it also works easily. That for St. Paul's was brought from the island of Portland: the Waycroft quarry at the north-east part of the island is a brownish Portland of excellent quality; the Westcliff and Bill quarries are also good. Ketton resembles but is better than Bath stone; Barnack is not so durable and is shelly in composition. Portland stone is stated to consist of 95.2 per cent of carbonate of lime, 1. 2. carbonate of magnesia and weighs 145 pounds per cubic foot. It cracks under a pressure of 2,000 pounds and crushes under 4,000. Purbeck, from the island of that name, is used for paving and steps, and also for fronting buildings; that from Swanage is of good repute. The quarries of Farleigh, Coombe, Down, Box, and Corsham produce the stone called *Bath*, in such very general use. The Chapel of Henry VII. in Westminster Abbey is faced with this stone, which is rapidly decaying, although so recently re-executed. Bath is much cheaper than Portland stone, but not so durable. It is soft when first quarried, but hardens on exposure; the grain is fine and the colour usually a warm cream. It absorbs moisture very quickly, and this consquently is one cause of its frequent failure. The weight is about 116 pounds per foot cube, the composition about $94^1/_2$ per cent carbonate of lime, $2^1/_2$ carbonate of magnesia, and these will absorb one third their bulk of water. Bath cracks under a pressure of 1250 and crushes under 1,500 pounds per square inch. The stone is cheap enough, but cannot be strongly recommended when durability is desired. Besides the above, there are other oolites more in local requisition. Those from Northamptonshire are superior to Bath, and not so expensive as the Portland. Ancaster, a Lincolnshire oolite, is generally used in the neighbourhood of the quarries. The Oxfordshire limestones are not very durable; Ketton and Barnack, of which we have before spoken, are superior. Among secondary limestones, there are some containing a great deal of magnesia, more especially those in the counties of Nottingham, Durham, and York. Magnesian limestones, which are suitable for building, consist of equal proportions of carbonate of magnesia and carbonate of lime in a perfect state of combination; their texture is crystalline, and the colour an agreeable yellow. They crack under a pressure of 5,000 and crush under 8,000 pounds to the square inch. The magnesian limestone of Bolsover Moor was selected by the Commissioners appointed as the most durable stone for facing the new Palace at Westminster. It was found to be the strongest and heaviest of all the specimens examined, and absorbed least water. The composition is 50 per cent carbonate of lime, 40 carbonate of magnesia; the remaining 10 silicia and alumina. The limestone from Caen in Normandy, particularly that from the quarries of Allemange, is remarkably good, and is used at the works at Westminster, and very generally in our churches and other buildings. Its grain is even, and the colour a beautiful cream. For internal use it is peculiarly suitable. For slabs, some limestones, which split easily, are quarried in Northamptonshire, Oxfordshire, and thereabouts. The Stonefield and Colley Weston slates are species of limestone. Chalk has ever been employed for repairing the cloisters of Westminster Abbey on account of "the cheapness of the cutting," but however deep the beds may be, the material should never be adopted. — We shall make under this, the most appropriate heading, a few remarks on ornamental stones and marbles before proceeding to the consideration of sandstones.

Alabaster, or gypsum, is often employed in ornamental architecture. The best or pure white variety is from Italy. France, Derbyshire and other midland counties in England produce it.

Oriental alabaster, a species of limestone of a warm yellow transparent appearance, is quarried in large blocks in Egypt. Alabaster must never be exposed to the action of water. *Serpentine*, a silicate of lime and magnesia, is superior to most marbles for many purposes. It is brought chiefly from the Lizard Point, Cornwall. *Spars*, particularly *Fluor spar* (fluate of lime), are of a blue colour and much transparency. Derbyshire produces admirable spars for ornamental purposes. Malachite is an ore of copper of a beautiful green colour; it comes from Russia and Australia.

Of marble generally "the external characters are as follows; colours white, grey, red, yellow, and green. It is generally but one colour, although it is often spotted, dotted, striped, and veined. Fracture foliated, but oftentimes inclining to splintery. More or less transluent, brittle and easily frangible. All the varieties may be burnt into quicklime. True marble consists of crystalline carbonate of lime, either almost pure, in which case the colour is white, or coloured with oxide of iron and other impurities communicating colour."

Of the ancient marbles we may mention *nero antico* (black), *roso antico* (red), *giallo antico* (yellow), and *verde antico* (green). We have not any now equal to the red and green, but the Sienna and Derbyshire are equal to the yellow black and red. The Parthenon was built of Pentelic marble (yellowish white), which is not equal to the Parian (carbonate of lime), which has a waxen appearance and retains for ages the most delicate touches, as is evidenced by the Venus de Medici. Carrara, used in the Pantheon in Rome, is much adopted now. The blocks are large, and besides the white statuary (like white sugar), there is much coloured and veined. The quarries at Sienna produce a fine yellow marbles. Our native marbles are also very valuable. The Devonshire, particularly those from Barbicomb, are spotted and veined with a variety of colours, from a bright red to a beautiful dove colour. Plymouth Breakwater is formed of blocks of Devonshire marble. The Purbeck, Petworth and Forrest marbles lose their polished surface on exposure, and are not to be recommended. The Derbyshire marbles are red, black, grey, etc., etc. The Anglesea resembles Verde antique. Ireland produces many black marbles. The Waterford, Toreen, Kerry, etc. are various in colour and texture. From Scotland the Iona, Tiree, Skye, Glen Tilt, Boyne, etc., are very fine. In France, Belgium, and other European countries marbles are also widely distributed, but with the exceptions above cited, are not much used in England. *Lapis Lazuli* is a stone of a beautiful azure blue colour, mingled with thready lines of a gold like metal; it is from China, Persia, and Great Bucharia.

SANDSTONES (*silicious*). These are generally composed of either silicious grains or quartz, cemented by argillaceous, silicious, calcareous, or other matter. They are frequently laminated, especially when *micaceous*, the plates of *mica* being deposited in planes parallel to the beds. Their decomposition depends on the loosening of the cementing substances, the grains being comparatively indestructible. Those which are united by ferruginous clay perish rapidly on exposure. A conglomerate, or pudding stone, is when the pebbles are large; and when the pebbles are entirely quartzy and the cement hard, or when there are cells ensuring a rough surface, we have a grind or millstone: the best are from Yorkshire, America, and France. Wo should warn our readers against the strata of sandstones marked with stripes or veins, as, although they have been preferred for fronts by reason of their beauty, the action of water on the iron, which these coloured parts contain, causes rapid decay. Those stones which are purely silicious are the best; when other substances are intermixed, decomposition is likely speedily to occur.

The sandstones chiefly adopted are the Cragleith, one of the most durable, of a lightish grey colour and a silicia cement; it is used for all kinds of buildings in Edinburgh, and in London for landings and steps; the blocks are procured of large size. The Darley Dale, near Matlock in Derbyshire, is an excellent sandstone; the Mansfield quarries in Nottinghamshire, and the Storton, near Birkenhead, produce cheap and good stones; and the Corn-Cockle Muir is of good texture

and even tint; the sandstones from Yorkshire are remarkably good. The flags are in constant use in London, and comparatively cheap. They are hard and tough, fine grained and laminated, from the millstone grit formation. The quarries are about Leeds, Wakefield, Halifax, and Bradford. The Caithness flags are from the old red sandstone beds, in slabs not so large as the Yorkshire; they are of a dark colour and very durable. While speaking of flagstones, we may mention the Irish Valencia and the Welsh Festiniog as excellent and beautiful paving materials. Kentish rag is a species of green sandstone in very general use and of extraordinary durability; the Tilgate, a Sussex stone, is also excellent.

ARGILLACEOUS. — The stones included under the generic name *argillaceous* are ill suited for building operations. Some of them, so hard at first as to resist firmly the point of the pick, become soft and shiver to pieces on exposure. This is because these stones, in addition to their clay, contain a large portion of iron, which, in the state of black oxide, combines rapidly with the oxygen of the atmosphere. "On this account basaltic stones are ill suited for durable architecture, though there are some stones of this class which appear more perfectly vitrified and resist the action of the atmosphere for ages. This is also the case with lavas, which are nearly allied to basalt; some lavas rapidly decompose, and form a fertile soil, others remain unchanged for centuries. In all stones called argillaceous, the quantity of alumine, or pure clay, is in fact generally less than that of the other earths. Alumine or clay, when pure, is soft and unctious and absorbs more than $2^1/_2$ times its own weight of water. It communicates, in a greater or less degree, its own proportions to stones where it is combined in the proportion of from 20 to 30 per cent. The properties of clay are lost by vitrification, or by exposure to a strong heat, as we may observe in the process of brickmaking. In the West Riding of Yorkshire, it is frequently the practice to mend the roads with argillaceous sandstone, but it is soon reduced to mud; to prevent which it is piled in heaps, with alternate layers of coal, and burned before it is laid upon the roads; this makes it more durable, but the heat is seldom sufficiently powerful to vitrify the stones, and the roads frequently want repair. The remains of vitrified forts in some parts of Scotland prove that the North Britains were acquainted with the durability imparted to argillaceous stones by exposure to great heat." Slate is a species of argillaceous stone in a state of partial crystallization and with the property of cleavage. The best are from North Wales, Delabole, Westmoreland, Cumberland, and Cornwall; in France from Angers and Brittany; and from Belgium in the Ardennes. Green and purple are the common colours; and slates may be tested by being either sunk entirely in water for 12 hours, then wiped and weighed, or sunk partially and observing how high the water is drawn. Good roofing slates should be rather rough to the touch, not soft and greasy, and emit a clear bell-like sound.

GRANITES (*silicious*). These are the oldest of rocks and astonishingly durable. Granite has three constituent parts; *quartz* (*oxyen*, and *silicium*), a grey glassy substance; *felspar*, also crystalline, but often opaque, of a pink or yellow colour, composed of sand, clay lime, and potash; and *mica*, a glittering silvery substance, consisting of flint and clay with magnesia and oxide of iron, and dividing readily into thin flakes. *Hornblende* is observed in some granites instead of mica, such as the *Syenite* from Upper Egypt, so durable as to preserve the mark of the chisel for centuries. *Porphyry*, another variety, contains enclosed in its mass little angular pieces of felspar in crystals; the colour is generally green or red. Serpentine has dark spots resembling somewhat those on the skins of snakes. *Trap*, or *greenstone*, is a hard, blueish stone, sometimes used in building; *syenite*, is a variety, and all traps are capital materials for macadamizing roads. Those granites generally which have much white felspar and but a small proportion of quartz, as those from Cornwall and Devonshire, decompose sooner than many of the Scotch, in which the quartz is more equally disseminated. That from Cornwall is called *moorstone*, or grey granite.

Red granite, sometimes yellowish with black mica, is found in Devonshire and some other parts. The Scotch, from Aberdeen and Dundee, is remarkable for hardness and durability and takes an admirable polish; the red is harder and more difficult to work than the grey. Peterhead, in the neighbourhood of Aberdeen, is perhaps at once the best and most beautiful of granites.

We have not space to make any remarks on artificial stones, but shall close our observations with the conclusions come to by the Commissioners for reporting on the best description of stone to be used in the Houses of Parliament. "Judging therefore from the evidence afforded by buildings of various dates, there would appear to be many varieties of sandstone and limestone employed for building purposes which successfully resist the destructive effects of the atmospheric influences; among these the sandstone of Stenton, Whitby Tintern, Rivaulx, and Craigleith, the magnesio-calciferous sandstones of Mansfield, the calciferous sandstone of Tisbury, the crystalline magnesian limestones or *Dolomites* of Bolsover, Huddlestone, and Roche Abbey, the oolites of Byland, Portland, and Ancaster, the shelly oolites and limestones of Barnack and Ham Hill, and the siliciferous limestone of Chilmark, appear to be among the most durable. To these, which may all be considered as desirable building materials, we are inclined to add the sandstone of Darley Dale, Humbie, Longannet, and Crowbank, the magnesian limestone of Robin Hood's Well, and the oolite of Ketton, although some of them may not have the evidence of ancient building in their favour." Limestones, particularly the crystalline, are preferred on account of "their more general uniformity of tint, their comparatively homogeneous structure, and the facility and economy of their conversion to building purposes." Sandstones absorb the least water, but disintegrate more than the magnesian limestones. The magnesian limestone from Bolsover Moor absorbed least water, was the heaviest and strongest of the specimens, and made the nearest approach to equivalent proportions of carbonate of lime and carbonate of magnesia. The Craigleith and Park Spring were the heaviest and most cohesive of the sandstones, and Ketton rag of the oolites, but the Bolsover Moor stone was preferred and recommended for use in the Houses.

DESIGN FOR A MANSION IN THE OLD ENGLISH STYLE.

PLATES 97. 98. 99. 100.

We give this design in juxta-position to the Italian Villa last described, as illustrating two very different styles of domestic habitations, one or the other of which will be preferred according to the peculiar tastes and feelings of different individuals. The style adopted in the design under description is that which prevailed in England during the latter part of the fifteenth century, or during the reign of the House of Plantagenet. The internal arrangements are however so changed as to be suitable to the comfort and convenience of the present time. The Italian design before given, is in the style gradually developed in Italy during the sixteenth century, on the revival of classical art and learning after Gothic art had ceased to be popular.

The accomodation provided in the Mansion is shown on Plate 97. On the Ground floor level are Drawing and Dining rooms, Breakfast parlour, and Library. A Conservatory communicates with the Corridors leading out of the spacious Hall. This latter is well lighted and has an open timber roof, similar to those formerly adopted in these mansions, and which is to be grained oak and varnished if that wood is not used. There is also on this floor, Kitchen, Scullery, stairs to

cellars below, Larder, W. C., and closets. The first and second Floors have each six rooms appropriated as Bed and Dressing rooms besides Closets. The octagonal Breakfast parlour and Bed rooms above in the Tower have windows commanding views in several directions; and the Bay windows in the other apartments are similarly advantageous. Plate 98 shows the two principal Elevations. The walls are to be of limestone, faced with hammered stones in irregular courses and pointed with blue mortar. Turn rough and counter arches, not less than 16 inches in height. The quoins are to be executed in Caen or Bath stone, in regular masonry, and finished with a neatly picked face and drafted angle. The heads and sills of windows to be in single stones, properly weathered, and the joints made water-tight in cement. Holes are to be drilled for the escape through the sills of condensed moisture. The carving is to be executed by a superior carver. The boundary walls, if of stone, are to be executed with quarry-faced stones, laid in random work and courses; a regular arris is to be preserved at the angles; and the top of the walls and the piers for gates should be of Bath or Caen tooled; the latter however may be built similar to the walls with quoins of Bath or Caen. The roofs are to be slated with grey slates, and the ornamental cresting to the Tower is to be of lead. Execute the Vanes of copper. Fir timber to be used; the windows to have wood casement sashes, and all the furniture to the doors, etc. to be of a Gothic pattern. Plate 99 contains a section and details of circular window, bay on side elevation, and finial. Plate 100 presents detail of principal bay window, with the plan and mouldings at large. The cost of the mansion, if executed in accordance with the description given, will be about £ 3,500.

DESIGN FOR A PAIR OF SIX-ROOMED COTTAGES.

PLATES 101. 102.

These are small but convenient cottages, also in the Gothic style of architecture. They may be erected of either stone or brick according to the proposed locality, or as may be preferred. The roofs are shown slated. We have met in the report on the 'Condition of the Labouring Population', previously cited, an objection stated to some stone walls used in preference to brick, which deserves serious consideration. "Wood and wattled houses, such as our forefathers built, are the driest and warmest of all; brick is inferior in both these requisites of a comfortable house, but stone, especially the unhewn stone, as it is necessarily employed for cottages, is the very worst material possible for the purpose. The evil arises from two causes. The stone is not impervious to water, especially when the rain is accompanied by high winds; and it sucks up the moisture of the ground, and gives it out into the rooms; but principally stone is a good conductor of heat and cold, so that the walls, cooled down by the outer air, are continually condensing the moisture contained in the warmer air of the cottage, just as the windows steam on a frosty morning; besides the abstraction of heat in stone houses must be a serious inconvenience. The effect of this condensation must be and is to make clothes, bedding, etc. very damp, whenever they are placed near the wall, and therefore extremely prejudicial to those who wear the clothes or sleep in the beds. Of course I do not attribute all the damp of our cottages to the stone; much of it is due to the wet climate, soil, and building so near the ground, but the stone as a material of building must bear a considerable share of the blame * * * Thatch placed in contact with such walls speedily decays, yielding a gas of the most deleterious quality. Stone chalk, bricks which are not thoroughly burnt, impure mortar, and concrete full of earthy particles,

have all a tendency to absorb moisture, which, if once received by such materials, ascends or *creeps up*, as it is technically called by builders, and thus affects the whole building. The action of damp entirely destroys a slate course, and the sand mixed with cement renders it in some degree porous. A course of well burnt bricks set in asphalt would probably effectually prevent the absorption of water." Paving bricks or tiles are also objected to for floors in the same Report, "as each of these tiles or bricks will absorb half a pint of water, so do they become the means by which vapour is generated. The cleanly housewife, who prides herself on the neat and fresh appearence of her cottage, pours several pails of water upon the floor, and when she has completed her task with the besom, she proceeds to remove with a mop or flannel so much of the water as the bricks have not absorbed. After having cleansed the cottage, the fire is usually made up to prepare the evening meal, and vapour is created by the evaporation of the heat upon the saturated floor." The present design contains, on the Ground floor, Entrance passage with W. C., and Closet under the Staircase. Parlour, with bay window, Kitchen, Scullery, Coal cellar, and Larder. On the Upper floor are three Bed rooms, together with a large Closet. Plate 101 contains the Ground Plan and Front Elevation; Plate 102 the Chamber Plan and Section. There is we believe little difference in the cost of Kentish Rag in its neighbourhood and stock brickwork, and the expense of the two houses if erected of it with tooled dressings will average about £ 500.

DESIGN FOR A SMALL VILLA.

Plate 103.

This little Villa, or "*cottage orné*," will not of course be suitable for a situation in which ground is particularly valuable, but without a design of such a character in a work embracing so great a variety, our series of domestic habitations would hardly be complete. We have heard many remark that if they erected a house it should have no staircase, and certainly when, as in Paris, houses are of great altitude the labour of ascending and descending is very great. The ancients scarcely ever used them, and where they are found in domestic habitations, they are usually for the purpose of access to the rooms of the *slaves*, as, for instance, at Pompeii. In houses with rooms all on the ground level, or but little elevated above it, the chief inconvenience is to be apprehended from damp, but this will be entirely obviated by a layer of concrete, 6 inches in thickness, laid over the whole surface to be built upon, rather deeper under the walls. Where two houses of this description are surrounded with trees and gardens, as would probably be the case with the present example, the flies coming in at the windows are a great annoyance. The Italian mode of excluding them, which is as old as the days of Herodotus, is peculiarly effectual. Small nails are driven in on the outside of the window frame about an inch apart, and small white or light coloured threads are stretched across both horizontally and vertically; or a network may be hung from the top of the window and fastened at the bottom and at intervals at the sides, the meshes not being above an inch square. Nothing will induce the flies to pass through this into the darkness; but if there is a through light from a side or opposite window, the contrivance will not be effectual . . . The present design will be found both roomy and convenient, with a certain picturesqueness of external effect. There are altogether nine rooms, in addition to the closets. There is a small covered Porch and Hall, the space of a Staircase being economized. The Drawing, Dining, and Breakfast rooms open out of the Hall (in which are two

closets); the windows of the Breakfast parlour are to go down to the floor, and be casement hung, one of them opening into the garden behind the house. Four Bed rooms are provided in addition to that appropriated to the use of the servant. The Kitchen is of a convenient size with lobbies opening into the Coal cellar and Pantry; a door cuts off all disagreeable smells from the Kitchen offices. A W. C. and additional Closets are provided in the Bed rooms and Passages. Stores may be formed and Cisterns placed in the expanse of the roof. The walls are proposed to be faced with Kentish red bricks, the parts left white with cement. The roof is to be covered with Italian formed zinc, the eaves to project at least two feet, with wood blocks, fascia, and soffite. The clear height of the rooms to be 11 feet 6 inches; the ceiling of the Hall to be circular, with groins from octagonal angles; it will be lighted from the lozenge shaped window in the elevation, and the passages by means of skylights. The rooms may be all ventilated into the roof space, one of the advantages of this description of residence. The cost of this Villa will be £ 600.

DESIGN FOR A FIRST CLASS TOWN MANSION.

Plates 104. 105. 106. 107.

This is a mansion of the first character and pretention, and although this work is devoted chiefly to those of a smaller description, one of this kind may find an appropriate place in it. The plans are so considered as to admit of a continuous row of houses as well as an isolated example. On the Basement, Kitchen, Scullery, Housekeeper's room, Servant's hall, Still room, Footman's room, Larder, Store, and Housemaid's closets are provided; Cellarage and W. C. will be in vaults under the street or at the rear. On the Ground floor are a spacious Dining room, with folding doors admitting of its division into two rooms, Morning room, Library, Butler's room, China closet, and W. C. On the First floor a Drawing room of the whole length of the frontage, Bed room, Waiting and Bath rooms, together with Closets and W. C. On the Second and Third floors altogether twelve rooms, for Bed and Dressing rooms, Boudoir, etc., with Closets. There are two Staircases, a principal and one for servants. The whole arrangement will be found convenient and appropriate, and the rooms are large, lofty, and well lighted. The frontage of the House is 44 feet, taking the full space of the side walls. The front elevation is of a highly ornate character in Italian architecture. The chimneys are treated as ornamental accessories adding to the altitude and dignity of the elevation. The front may be executed in either stone or cement; if the latter be adopted and the internal fittings be in accordance with the luxurious character of the mansion, the cost will average £ 3,600.

DESIGN FOR A VILLA.

Plates 108. 109.

This House is adapted for an open spot, although with a little modification, others might be erected continuously. There is no Basement, the Kitchen offices being on the Ground floor, which is raised two feet above the level of the ground, and contains Drawing room, with folding

doors communicating with Morning or Breakfast room, Dining room, Kitchen, Scullery, with the requisite Closets, etc. A Staircase is shown to lead to Cellars if desired. On the upper floor, there being only two, are eight apartments appropriated as Bed and Dressing rooms, besides Closets. The simply oblong form of the house, without breaks and recesses, has many advantages. It is always the most economical, and allows of the simplest possible kind of roof. Where also there are many angles to a building, damp is more likely to be retained, as the sun cannot shine so equally on the walls, and the angles are apt to retain moisture. They are here shown cemented, as certainly tending to preserve dryness. The Elevation has a breadth and simplicity of effect which will be found eminently pleasing; the roof is shown with rolls and may be executed in zinc or galvanized iron, the latter most expensive. Faced with Kentish red bricks or second malms with cement dressings, the cost will average £ 1,300.

DESIGN FOR A MODEL COTTAGE.

Plates 110. 111.

This Design completes our series of Model Cottages for Labourers, Mechanics, etc. The first is for a pair, with two floors, the second for four, the third for one, with the rooms all on one level, and the last, that under description, for a detached cottage with rooms on two levels. There is thus a variety suitable for various circumstances, from which a selection may be easily made. The present example has an Entrance lobby, Living room, Scullery, with oven, copper, etc., etc., Larder, Coal cellar, Closet for tools, and W. C., all on the Ground floor. The Chamber floor contains three Bed rooms and a Closet. The arrangement is compact with no loss of space and economical. For the general requisites and the particulars of construction in different parts of the country, the reader is referred to the lengthened remarks at page 94, where will be found a Specification applicable to this example. We therefore only need add here that, if the cottage is built of stock bricks and fir timber, with a slated roof, the expense will be about £ 180. A section showing the construction is given.

DESIGN FOR A SEMI-DETACHED TOWN HOUSE.

Plates 112. 113.

These are convenient residences, each containing eight rooms with two small Dressing rooms. On the Basement are Kitchen, Scullery, Larder, Store, and other closets, with Cellarage under the street, communicating with the front area. The Ground Plan contains Entrance hall and Hall, Drawing and Dining rooms, communicating by means of folding doors, back Lobby and W. C. The First and Second floors have each two Bed and Dressing rooms and Closets. The Houses are planned so that they may be erected either semi-detached or in a continuous row.

The Elevation is of an Italian character, simple, inexpensive, and unobtrusive; the roof is concealed by a parapet. Faced on the principal front with second malms and cement, the cost will be for the pair £ 2,100.

DESIGN FOR A SUBURBAN VILLA.

Plates 114. 115.

This house is planned with studied irregularity, with the view of obtaining the greatest amount of external picturesque effect. The tower is a prominent feature, and is not, as is too often the case, a comparatively useless adjunct, but serves to contain an open and well lighted staircase, which, in general, should be its use in houses of this description; in the roof the cistern for water supply is placed. On the Ground floor, a Porch leads to the Hall in its base, which communicates with a Corridor, into which the doors of the Drawing and Dining rooms and that cutting off the Kitchen offices open. These latter are conveniently arranged. There is a tolerably large Kitchen, a Scullery and Larder, China closet, Coal cellar, and W. C. The two latter are placed so as to be accessible without entering the Kitchen department. The lower part of the China closet will probably be appropriated for wine. The First floor has three Bed rooms, besides W. C. and Closets. The second Floor has a similar number of Bed rooms and Closets, and another Bed or Smoking room may be placed at the summit of the tower; above it the cistern. There is a side entrance for tradesmen, and a verandah may be placed at the back of the Dining room, a lobby leading out to it from the main corridor. This will altogether be found a convenient family residence, and may be erected of stock bricks and cement for the sum of £ 1,500.

MASONRY.

We propose in two articles to sum up a brief view of the practical details of the Mason's art, without entering into its history and the complex theory of the principles of strength and stability, both of which subjects would necessarily occupy too much space to be at all satisfactorily considered. The characteristics of the several materials have been already treated, and sufficient has been stated to enable the reader to form a correct idea of the crushing weight or resistance of stone walls, on which their stability greatly depends. We shall not also, for the reason above stated, make any remarks on the pressure of earth and fluids against retaining and breast walls, and the resistance of isolated walls to forces which tend to overturn them. The theory of the equilibrium of arches would also require great space, but some observations on this important subject will be found in an early part of the work. The tools used by the Mason are varied according to the peculiarities of materials, and an inspection of them will convey a far more accurate idea than any written description. The different descriptions of Walling will first engage our attention.

The footings must be constructed with stones as large as possible, of equal thickness in the same course and with the broadest part at the base. Rectangular forms are preferable; if not square, they must be hammer-dressed into shape, the longest surfaces being laid horizontally; stones which taper downwards and rest on angular ridges will be very apt to give way. It is of course preferable to have stones reaching entirely across the foundations, but in very thick walls, when stones cannot be procured of sufficient size, every second stone may be a whole stone in breadth, each interval consisting of two stones of equal breadth; that is, placing header and stretcher alternately. If these stones are not at hand, a header and stretcher may be laid alternately from one side of the wall, and on the other, a series in the same manner, in order that the breadth of each stretcher may be one third of the breadth of the wall, the length of each header two thirds, and the back of each of the latter come in contact with the back of an

opposite stretcher, and the side of the header with the side of that adjoining the stretcher. When stones cannot be procured of lengths equal to two-thirds the breadth of the foundation, the stones are to be laid so that the vertical joints of the courses may lie in the centre of the lengths of the stones in the course beneath, and the back of each stone fall in the solid of the stones below. The sets-off should not exceed 3 or 4 inches, and the number of footings is regulated by the height and pressure of the wall.

Walls may be generally divided into *ashlar*, consisting of hewn or squared stones, in distinction to those formed of unhewn or rough as it comes from the quarry, and termed *rubble walls uncoursed or coursed* in various manners.

Walls are also often faced with ashlar work, the backing being of rubble or bricks. *Rag work* is a species of flat bedded rubble; in *herring-bone* work the stones are laid aslant. We will first consider ashlar, hewn, or squared work.

The stones may be of any suitable size; cubes are the strongest, but their stability and bond is not equal to those whose length is greater than the height. Stones are very often used too thin, and fracture from not resting equally on their surfaces. In practice the blocks may be safely made from twice to three times their height; and if the stone is moderately hard, the width may be once or twice the height. Very hard stones may be two or three times their height in width, and four or five times in length. Crossing the joints efficiently is a better mode of bonding than using very large stones, unless very strong; and if they are about three times their thickness in length, they are extremely liable to break from the unequal pressure, the fracture taking place opposite a joint. It is preferable so to sort the stones that in each alternate course they may extend further into the wall than those of the courses above and below, and to make the thicker and thinner courses in height follow one another. All stratified stones also are far more durable when laid in the same direction they occupied in the quarries; and as they split more easily in a direction parallel with the surface of the strata, they will consequently bear less pressure in this direction than in one perpendicular to it. The mortar used is of the highest importance; that adopted in the ancient structures is so fine as to fill only the inequalities of the stone, without preventing the courses bearing fully upon another. A medium should be observed in this respect; for if the mortar be thicker than necessary, the work takes a long time to settle and is rarely perfectly stable; if the layer is too thin, the bedding will be insufficient; and if the stone be of an absorbent nature, the mortar will dry too rapidly to acquire a proper degree of hardness. Bond stones require particular attention in the long courses above and below windows. The sides ought to be parallel, perpendicular to each other, and the horizontal dimension on the face never less than the vertical. The vertical joints should widen slightly to the back, to form a hollow for the reception of mortar and *packing*, after receding three-quarters of an inch, with a close joint from the face; they are sometimes dressed to a depth of 4″ from the face. The beds and vertical joints of the adjoining stones are to have the beds and vertical joints filled with oil putty to three quarters of an inch inwards, and the rest of the beds with mortar carefully prepared. Putty cement will often last longer than the stones, and although the oil spreads over the surface, the disagreeable appearance soon wears away. Ashlar facing alone is from considerations of economy very frequently used, backed with brick or rubble. This description of work is not however to be recommended. The settlements of the respective materials are so different during the setting of the mortar that the *two* walls continually separate and become convex; and when this is attempted to be obviated by means of bond stones, a bulging outwards and an unequal bearing at the base are very apt to occur. It is obvious that there must be a much greater quantity of mortar in the backing than in the facing of these walls, and, as its shrinkage is in proportion to this, there can hardly be worse construction. The back courses must be kept as high as possible, and very little mortar used; the stones must be closely

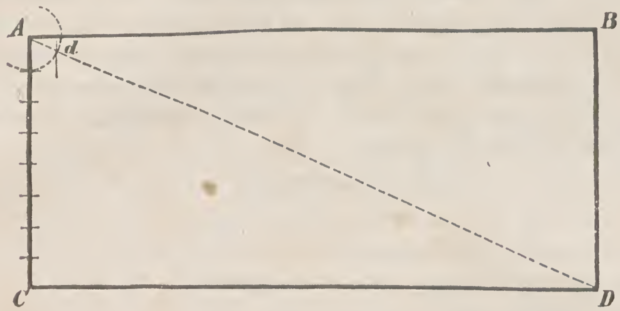
packed together, and the common practice of throwing mortar in, to save the labour of filling in with stones, must be absolutely prohibited, as the walls are thus often bulged by the hydrostatic pressure of the mortar. Fig. 13, Plate 18, shows a good method of building these walls, through stones, forming an admirable bond. Wood bond, used for coursed rubble and brick backings, is not to be recommended. When plentifully used and very long, it weakens the masonry, rendering it liable to bend; and it warps in case of fire. Small pieces, as for the fastening of battens, etc. should only be used, with the fibres of the wood perpendicular to the face of the wall. Bond, or through stones, should be proportioned to the length of the courses in number, every one falling in the middle between the bonders next below. The practice of making bond stones longer than is necessary and afterwards breaking the ends off is to be deprecated, on account of the liability of splitting the stone, and shaking the wall in reducing the projecting part. When the jambs of piers are coursed in front with ashlar, it is best to make every alternate jamb stone go through the wall with its jamb quite level. If, as is frequently the case, the jamb stones are of one height, every alternate stone, at the end of the courses of the piers, should be a bond stone, and no other bond stones will be required if the piers are not very broad. If the stones of facing are not laid on their natural beds, they are apt to flush at the joints, and be injuriously acted upon by the atmosphere. If the upper and under surfaces are not strictly parallel and at right angles to the face, but are left concave, they will be apt to splinter at the edge; when the stones are of about equal thickness, it is advantageous with regard to bond, that the back of the stone be inclined towards the face, and all the backs inclined in this way run in the same direction, as a lap is obtained in the setting of the next course; and it is obvious that, if the backs are exactly parallel to the face, there cannot be a lap if the stones are of equal depth. The stones for ashlar facing are generally 28 to 30 inches long, 12 or 18 inches high, and $4^1/_2$ to 9 inches thick, but these dimensions are of course considerably varied. The stretchers may be $4^1/_2$" and the headers 9" deep, with bondstones in the proportion of $^1/_{16}$th of face, reaching through the wall. Where the backing is brickwork, the facing and bond stones must of course be cut to sizes that will bond well with it, as the vacuities left will tend to separate the facing and the backing. Columns and pilasters look very fine when in a single block; if in several, there must be as few joints as possible; vertical ones are inadmissable, and the stones are to be selected of an uniform appearance. The joints should be rubbed and have joggles let in, and bedded in cement, with 4 lb. milled lead between each joint, and to within one inch of the external surface; the remaining space being filled in with a composition of stone dust, resin, and bees-wax or oil putty, sometimes only $^3/_4$ inch deep, with the remaining space occupied with fine mortar. The flutes and capitals should be worked after the columns are fixed. Nothing is worse in appearance than a flushed joint, breaking off in flakes, which will certainly occur if the beds are concave, or hollow. They are better slightly convex. To ascertain the exact diameter of each stone, "draw an elevation of the proposed column to the full size, divide it by lines, parallel to the base, into as many heights as the column is intended to contain stones, taking care that none of the heights exceed the lengths that the stones will produce. The working of the stones to the diameters thus obtained then becomes easy. The ends of each stone must first be wrought so as to form exactly true and parallel planes. The two beds of a stone being thus formed, find their centres and describe a circle on each of them. Divide these circles into the same number of equal parts, which may, for example, amount to six or eight. Draw lines across each end of the stone, so that they will pass through the centre, and through the opposite divisions of the same end. The extremities of these lines are to regulate the progress of the chisel along the surface of the stone, and therefore, when those of one end have been drawn, those of the other must be made in the same plane, or opposite to them respectively. The cylindrical part of the stones must be wrought with the assistance of a straight edge; but for the swell of the column, a diminishing rule, that is, one made concave to the line of the column, must be employed. This diminishing rule will serve to

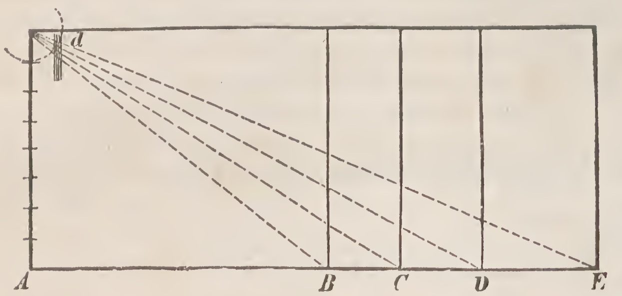
plumb the stones in setting them. If it be made the whole length of the column, the heights into which the elevation of the column is divided should be marked upon it, so that it may be applied to give each stone its proper curvature. But as the use of a long diminishing rule, when the stones are in many and short lengths, would be inconvenient, rules corresponding in length to the different heights may be employed with advantage."

Rubble walls consist of unhewn stones, sometimes with or without mortar. They are of two descriptions, *coursed* and *uncoursed*. In the first, the stones are guaged and dressed by the hammer and thrown into heaps containing stones of the same thickness; they are laid in horizontal courses, not often of the same height. Uncoursed walls are laid with stones as they come to hand, without guaging or sorting, the sharp angles being knocked away with the thick end of a scabbling hammer. On the surface they are either simply *self* or *quarry faced*, *axed* or *hammer dressed*, or *tooled*, with quoins of picked stones, squared and well bonded. The quoins and dressings are often of a superior stone with a neatly *picked face* and *drafted angle;* sometimes they are *rubbed*. Occasionally the quoins are formed with "long and short work," consisting of pilaster-like strips of stone, as shown on Plate 18, Figs. 7, and 8; this is common in Anglo Saxon work. Rubble walls are often formed of flints, broken to a flat surface on the outside, and these are sometimes used as ornaments in squares and lozenges. *Rag work* is flat bedded stuff of about the size of bricks and is generally laid horizontally. In *herring bone work*, the stones being laid aslant, the workman is enabled to level off the work at each course. On Plate 18, we have given illustrations of the different descriptions of walling, beginning with those of the Greeks and Romans. Fig. 1, is the *opus reticulatum*, thus termed from its net-like appearance, obtained with square stones placed diagonally, a mode of building common in the time of Vitruvius. Fig. 2, is the *opus incertum*, randum or rubble walling. Figs 3, and 4, are the *isodomum* and *pseudisodomum*, consisting of regular courses of unequal and equal heights. Fig. 13, the *emplectum*, is the mode commonly used at later periods of the empire, and in France and England. It resembles the two last described in external appearance, the middle of the wall being filled in with rubble. The courses were usually about 4 inches deep, the stones of cubical proportions, and the joints wide and coarse. Sometimes tiles were built in at intervals, as in Fig. 10, their flat surfaces forming a good bond; they do not appear to have been cast in a regular mould. When large blocks of stone were employed, the Romans used no cement. Flint too was very commonly used by them in England, embedded in mortar with bonds of flat brick or tiles. In Egyptian masonry, immense blocks, often thirty feet long, were employed; the Cyclopean at Tiryns and Mycenæ is of large irregular masses with smaller pieces in the interstices; and the Etruscan similar, but fitted accurately, so as not to allow of smaller pieces being inserted. Fig. 5, is rubble work of the Middle Ages, 6, coursed work, 7, and 8, long and short work, 9, herring bone work, 12, the modern Italian regular masonry.

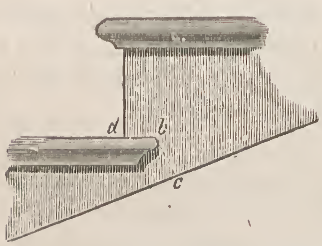
For some observations on *Arches* in walls the reader is referred to Page 89. The formulæ for calculating their equilibrium are too intricate and lengthy to be introduced here, and the figures 20, 21, 22, Plate 18, explain themselves. In oblique, or *skew-arches*, the courses are laid at right angles to the front of the arch, and at an angle with the abutments. The ends of the courses are at different heights, and the inclination of the bed joints increases from their springing to the crown, causing the beds to wind or twist, and giving rise to many difficult problems in stone cutting. We shall conclude our observations on walls with the formula given by Rondelet in "L'Art de Bâtir" for obtaining their thickness. Of course the connection of walls with one another and their being covered with wood roofs or arches, and having floors forming ties, considerably modifies the requisite thickness. A, B, C, D in the diagram being the elevation of the proposed wall, draw the diagonal A, D. The height A, C must be divided into eight parts for an undoubted, ten for a mean, and twelve for a minimum stability. That in the example being divided into eight parts, from A as a centre describe the arc cutting A, D at a, and a line being drawn

through it parallel to A, C, the required thickness is obtained. When there are four walls, the operation may be abridged as shown in the following wood-cut, A, B, C, D, E being the respective lengths of the walls.

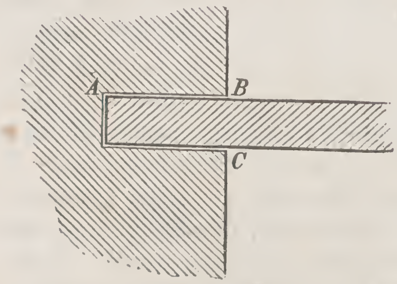




With respect to *Staircases* we have explained at page 158 the several kinds. The mode of carrying them up is very simple. We have to consider the form of the steps and that of the *limon*, or string. The ends are either terminated in a solid *newel*, or tailed into a wall surrounding an open newel. If the newel is not made more than 2′ 6″, a solid pillar may be adopted; if the newel is larger, a thin wall is cheaper; steps are sometimes supported by a dwarf wall. In *geometrical* staircases, the end of each step being fixed in the wall, it is carried by the step below as shown in Fig. 2, Plate 19. A joggled joint, with a uniform surface, terminated at one side by a notch or rebate, is the form adopted in practice. The outward end is shown in the margin; a b is made about an inch, and b c perpendicular to the soffite of the stairs, and the depth is regulated by the character of the stone; thus it is evident, that no step can descend in the inclined direction of the plane or in a vertical direction; the sally of every joint forms an exterior obtuse angle which, on the lower part of the upper step, is termed a *back rebate*, and on the upper part of the lower step, an *interior rebate*, the joint of these sallies being a *joggle*. The steps are to be pinned eight or nine inches into the wall, more or less, according to the length of the steps; they are thus altogether sustained without the aid of a string. For a step 4 feet in length, the thickness of every step at its thinnest part need not be above 2 inches, measuring from the internal angle perpendicular to the rake. The length of the steps must be considered, and it is a safe rule to make the least thickness of steps, as the inner angle equal to half the number of *inches* of the height of the step in feet. The *landings*, *half-paces*, and *quarter-paces* of stone stairs may be connected with the steps in the manner above described. If they are formed of more than one stone, the first is connected in the above manner with the step below, and tailed into the wall, the next stone being rebated or joggled into it and so on. "The principle upon which stone geometrical staircases is constructed is, that every body must be supported at three points placed out of a straight line; and therefore, if two edges of a body in different directions be secured to another body, the two bodies will be immoveable in respect to each other. This last case occurs in the geometrical staircase, one end of each stair being tailed into the wall so as to be incapable of tilting, and another edge resting either on the ground itself, or on the edge of the preceeding stair stone or platform, as the case may be. The stones which form a platform are generally of the same thickness as those forming the steps." It is of the utmost importance that landings, balconies, and steps should rest as firmly and as evenly as possible on their supports. The diagram shows a step or landing fixed in a wall; it is evident that the weight of the projecting part will tend to lift up that fixed at A, and lower it at C. As a less



force is required to sustain the step at *A*, than between *A* and *B*, the effectual resistance should be on the upper side at *A*, and on the lower at *C*, close to the face of the wall. On Plate 19, some illustrations of staircases are given. Figs. 3, 4, and 5, are ordinary plans in common use, to which the preceding remarks especially apply. Figs. 6, 7, and 8, are extraordinary plans; Fig. 6, and particularly 7, showing somewhat remarkable dispositions of the steps.



(To be continued.)

DESIGN FOR A PAIR OF SEVEN-ROOMED VILLAS.

PLATES 116. 117.

On the Ground Floor are Hall, Drawing and Dining rooms, Kitchen, Closets ana steps to Cellars in Basement. On the Chamber Floor, Three Bed rooms, Dressing room and Closet are placed. The breaks and projecting chimneys produce a varied effect in the Elevations, and the cost of the Pair, if erected with stock bricks with cement dressings, will be £ 600.

GLAZING AND PAPER-HANGING.

We have only to make a few observations on Glazing and Paper-Hanging to complete our general observations on the Fittings and Finishings of Domestic Habitations. Fixing glass in lead work, or *cames*, strengthened by *saddle bars*, is the oldest description of glazing, and is still used for cottages and churches; that in *sashes* being now more generally adopted. *Crown* glass is blown in circular flat disces or *tables*, 52 inches in diameter. 5 measures of sand, 2 of ground chalk and 1 of carbonate of soda, are the usual proportions of the ingredients. It differs from *flint* glass in not containing lead, or metallic oxide, except manganese and sometimes oxide of cobalt. There were formerly two kinds manufactured in London; the Ratcliffe, the cheapest and the best, and the Lambeth, darker and greener. Owing to the expense of fuel, there are now, we believe, no glass houses in London; the manufacture is carried on chiefly at Newcastle and Bristol. Crown glass is sold in *crates* which contain 12 tables, if of the best quality, 15 of the second, and 18 of the third. Squares may be easily procured 33 by 25 inches. *Bests, seconds, thirds,* and *fourths* may be had; the two last are of a greenish hue. The glass of stables is always liable to decomposition and to show the prismatic colours, which is owing to the ammonia constantly disengaged and affecting the silicia of the glass.

The manufacture of *Cylinder* or *sheet* glass originated in Germany, and is sometimes called German plate glass. The English have of late years considerably improved in the manufacture of it, and the terms British sheet, patent plate polished, broad, spread, and inferior window glass, are names applied to it. It is now inferior to the best crown in lustre only.

Plate glass is cast in large sheets or plates, and is composed of white sand purified, and pearl ashes and borax. Apsley Pellatt mentions 400 lbs. of Lynn sand, washed and burnt, 250 lbs. carbonate of soda, and 30 lbs. of ground chalk as good constituents. It is polished by being laid over a large block of freestone quite smooth, and then a smaller piece of glass passed over it. A slight excess of manganese produces a very delicate amethystine tint, improving the appearance of the complexion of those who receive the light through it, a fact suggestive to the ladies. The manufacture of plate glass is very expensive, and consequently in the hands of a few companies. The French is superior to ours, but is not used for glazing, as it suffers from exposure. *Coloured* glass has various metals, sometimes in the form of oxides, in its composition. Blue, purple, and neutral tints are the cheapest; then yellow and Lemon, Orange and Green, Red and Ruby most costly. In *stained* and *painted* glass, the fluid vehicles are applied with brushes, and the artist must have much skill to judge of the effects, as the firing produces great changes. Patterns often repeated are sometimes printed on the glass. Many of the varieties of ornamental glass are derived from the Venetians, who were greatly celebrated for its manufacture. Glazing with stained glass is executed in small pieces set in a lead framework, called *fretwork.* Glaziers putty is composed of linseed oil and pounded whiting.

The art of the Paper Hanger is the simplest of those connected with building and therefore calls but for few remarks. Like that of paper making it is derived from the Chinese, and the English were the first thus to copy them in covering their apartments. A piece of paper is 12 yards long and 21 inches wide, thus containing 7 square yards or 63 feet super. One piece in seven is usually allowed for waste. The French piece contains $4^1/_2$ yards super: 12 yards, or 36 feet run, is equal to a dozen of borders. To obtain the quantity of paper required for a room, it is only necessary to find the superficial surface in feet, and divide it by 63, which will give the number of pieces; or dividing the number of superficial feet by 5 will give the number of yards running, and dividing these by twelve the number of pieces, and if any odd yards remain they are charged as one piece. The walls should be pumiced, sized and prepared, and sometimes lining paper, canvass linings, and india rubber paper for damp walls are applied; this last is about two shillings and sixpence per piece. Sizing two coats and varnishing paper is from two to three shillings per piece.

In a previous page will be found some remarks on the sanitary objections to paper hangings; there can be no doubt however of their comfort, convenience and the cheapness with which a cheerful and pleasing finish may, by their means, be given to apartments, provided they are simple and in good taste, which however is very rarely the case. The violations of all propriety, and of the rules of common sense in our paper hangings is something very remarkable. Nothing is more common than to see representations of buildings, landscapes after a kind, figures of men, women and animals from the floor to the ceiling, all floundering about one above the other, and ships and water in every imaginable confusion. Columns, pilasters, architraves, carrying nothing and meaning nothing, are exceedingly common. Again all manner of shadows are thrown where none could possibly exist, sometimes from the light, sometimes towards it; it being apparently of very little importance which, provided the shadows are there. The absurdity of repeating a perspective over a large surface with some hundred different points of sight would be, we should have imagined, obvious. Panels indeed admit of figures and views, but they should be treated consistently, and the interiors of our apartments are the reverse of appropriate models of taste. The wall should be considered as a back ground, as what it is—a flat surface; and the colours be so arranged as to give repose to the eye, and contrast with the furniture. There must not be that bright spotty effect, carrying the eye a dance about the room, bewildering and confusing it. Strongly marked lines and sudden contrasts are bad accompaniments to furniture, and the worst back ground for pictures. All must be quiet and harmonious, the patterns consisting of conventionalized, flat forms of leaves and geometric designs. No shadows whatever must be

permitted, as the truthful appearance of flatness is destroyed by them, deception is admitted and common sense violated. No natural objects should be represented, as they are absurdly out of place. The introduction of tablets, or divisions with appropriate sentences and mottoes, is an old custom deserving revival. Papers of a large pattern tend to reduce the appearance and size of a room, and the height is also affected, especially by those of flowing patterns; but, if perpendicular lines predominate, the height is not so much lessened. Papering the ceiling makes it seem lower. Rooms with a northern aspect should be papered with warm colours, those towards the south with cold tints. As the expense is the same in cutting a good or a bad block, there can be no excuse for bad designs; and paper of even two blocks or colours may be made exceedingly simple and effective, while the variety of the miserable patterns we see, walls of strawberries and roses, ships floating on each others masts, happy cottages in the most unhappy and unseemly of positions, are all quite astounding. Diaper patterns in self-tints are safest, and the colours must be so intermixed and toned as to present a neutralized bloom at a distance.

Stencilling was the earliest method of manufacturing paper hangings. Printing patterns from wood blocks of pear tree, or sycamore, with as many blocks as there are shades and colours, was next adopted. In machine printing an endless roll of paper is printed in different colours, but it is not so well nor so cheaply done as that by hand, and does not succeed with satin and glazed grounds.

DESIGN FOR A WAREHOUSE OR FACTORY.

Plate 118.

The internal dimensions of this Warehouse are 62 by 54 feet. There are three Floors and a Basement; on the Ground Floor, a shop and Clerk's Private Office are shown. The height of the Basement is 12 feet; that of the Ground and First Floor 14 feet; and the Second Floor 12 feet. Cast iron columns, carrying girders, are shown, preserving an open space within; and an iron circular staircase is placed in the centre of the building. We have avoided in the elevation that absurd practice of introducing a number of small separate windows, giving a dwelling house appearance to Factories and Warehouses, and conveying the idea that the interior is divided into a number of separate apartments. We have also endeavoured to preserve more *character* than has lately been given in London to these structures. With a cemented front the expense will be about £3,400.

DESIGN FOR A PAIR OF SUBURBAN RESIDENCES.

Plates 119. 120.

Each house has a Kitchen, Scullery, Servants' room. Pantry, Closets, W. C. and Cellar on the Basement; Drawing and Dining, and Extra rooms, W. C. and Hall on the Ground Floor; and three Bed rooms, Dressing room, W. C. and Closets on the Chamber Plan. Cement and red bricks are proposed to be employed in the fronts, with Italian formed zinc roof. Erected

thus with ordinary stocks, and fir timber, the internal finishing of fair quality, the expense of the pair of houses will be £ 1,250.

MASONRY.

(CONTINUATION.)

We shall now make a few observations on the methods of joining stones. The scientific operations of stone cutting are founded on geometrical principles, and great skill is requisite to form and put together the complex vaults, domes, tracery, and other works in the highest departments of the art. Within our limits it is impossible for us to treat of these. We may state generally that the method adopted in stone cutting is to form such plane surfaces as are necessary, so that these may include the ultimate form with the least possible waste, or in a shape most convenient to apply the moulds. The method of obtaining a plane surface is shown on Fig. 14, Plate 18. What are called *chisel draughts* are first made by knocking off the superfluous stone until it coincides with a straight edge, and the rest of the stone is next cleared off until the whole surface is uniform. Fig. 15, shows a moulded surface. Two parallel draughts are made at each end of the block coinciding with a *mould*, and that left between is afterwards cleared off, the work being kept true by a constant application of the mould. Stones, for walls, which are very unshapely are, previous to hewing, brought into something of required form with a scabbling hammer or other instrument. Stone is divided into scantlings by the saw and wedges, and hard stones are reduced to a surface by the chisel and mallet. *Pointing* is working the surface with a point into narrow furrows with ridges between them; these are cut away with the *inch* tool, and the boaster renders the work nearly smooth. There are two kinds of operations with the tool, termed *stroking*, and *tooling*. In London, facing stones are usually *stroked*, *tooled* or *rubbed*. Stones are taken out of winding with points, and finished with the inch tool. In country districts where, by the operation of sawing, the stone saved does not compensate for the labour, the mallet and chisel only are used. When the farrows left by the chisel are disposed in regular order, the stone is termed *fair tooled;* if otherwise *random-tooled*, *chiselled*, *boasted*, or *pointed*. In soft stones the surface is brought to a smooth face with a *drag* (a plate of steel indented like a saw) to take off the mark of tools. Fine grained stones are rubbed with sand. Hard stones are *random-tooled*, *fair-tooled*, *chiselled*, *boasted* or *pointed*, *rusticated*, etc.; others are used *self-faced*, *quarry faced*, *axed* or *hammer-dressed*, *picked face*, *worked fair and rubbed*. Marbles are polished with grit stone, pumice stone, and emery or calcined tin. Granite and grit stones are roughly *scappled*, or brought into shape; if the face is left rough from the quarry it is termed *quarry pitched*. In Scotland *droved* is the term applied to random tooling in England, or boasting in London. The *punch* is the same as the English point, and its work is called *broaching*, the stone being first droved, as also is striped work. In Aberdeen the granite is picked with the scabbling-hammer until the surface is very near the requisite form, which operation is termed *nidging*.

Morticing, *tenoning*, and *dovetailing* stones differ little from the same operations in joinery. In works where great strength is required the stones are sometimes dovetailed or locked together with considerable compactness, as those at the base of the Eddystone and Bell Rock lighthouses. Figs. 16, 17, and 18, Plate 18, are examples of stones joggled together, a projection in one being made to fit a groove in another. This necessarily causes great labour and waste of stone, and dowel-joggles (Fig. 17), consisting of pieces of hard stone, slate, etc. inserted in grooves, are preferable. *Cramps* and dowels are used to prevent stones sliding upon one another and to secure them firmly in their places. Fig. 11, illustrates their application. Cramps are best of a dovetail form, and they are made of iron, wood, stone, copper, etc. Bronze cramps were used in the Coliseum, and oak dovetails in the Parthenon. Cast iron cramps are bad, the wrought worse, like a series of wedges, oxidating and splitting the stone to pieces. If of iron, they should be

galvanized if exposed to the air; iron cramps do not affect brickwork. Cramps of York or other hard stone are preferable to iron for copings, as the iron are not only unsightly and productive of stains, but tend to split the stone. After cramps are put in place, melted lead is poured in, which fills up the vacancies, binding the work securely together. *Joggles* or *dowels* are used to columns, pinnacles, and to connect stones placed above one another, and in other relative positions. Copper is the best but most expensive material; wood, stone, slate, and iron are used; the latter tinned, or it will split the stone. As a general rule, lead should be avoided, the best kind of work consisting in the use of close, smooth, even, workmanlike joints, fine mortar, and accurately fitting dowels.

We have not room to enter into the subject of the scaffolding used by the Mason. It is double, consisting of two rows of standards, quite separated from the walls, putlog holes being inadmissible. The use of round poles has been in a great measure superseded by square timbers, secured with dog-irons and bolts. The travelling crane, running on a tramway, is used to hoist the stone, which is secured by means of a *lewis* shown in Fig. 19, Plate 18. The moveable derrick crane is also much used. It is a vertical post with two timber back stays and a moveable derrick hinged against the post. Of centering we shall only observe, that it should be strong enough to resist any settlement, admit of easing with facility, and injury should be avoided, that it may be adapted for future use. Fig. 22, shows a form of centering, the projecting stones at the base of the arch being cut away when the work is completed.

Some minor details of the Mason's art now require to be specified.

The *steps to stairs* may be either quarry steps, or tooled, or rubbed. York stone stairs may be of quarry steps $13'' \times 6^1/_2''$, back jointed and pinned into brickwork; sometimes they are tooled, the bottom step solid, with semi-circular end, the others feather-edge, all rebated and joggled together, the clear width of tread being 11 inches. York stone treads and risers, $2^1/_4''$ thick, tooled and pinned into brickwork in cement, are cheap. Portland stairs may have solid, rubbed, rebated, and back-jointed steps, with weathered soffites tailing 9 inches into walls, which tailing is left solid; the lower step to have curtail end, nosings moulded and returned at side. The soffites are moulded to the shape of the ends of steps, or plain wrought. Circular newel stairs may have steps 11 inches broad, rising 7 inches, with newels worked on the newel end, and tailing into wall 4 inches; the steps square and fair tooled all round. Holes must be cut for balusters. Quarter spaces and landings of stairs are from 3 to 7 inches thick, tooled or rubbed both sides, with joggled joints, run with lead or set in cement, and tailed into wall 4 or 9 inches; they are back jointed or rebated for the steps rising to and from them, and the edges moulded or square. Balconies are similarly described, properly tailed into the wall and pinned up. The size of steps to doorways must be described in Specifications and they should be always weathered. They are self faced, tooled, or rubbed, back rebated to one another or to paving, housed at each end into brickwork and mortised for door posts, or have holes cut for rails, as the case may be. Steps to front entrances should be of Portland rubbed, with moulded nosings; to back, Yorkshire, tooled, with square edges. Yorkshire paving is from 2 to 4 inches thick, rough, tooled, or rubbed, bedded in mortar and close jointed in it or in cement; it is generally used $2^1/_2''$ inches thick, tooled. Portland Bath and Caen stone *paving* is $1^1/_2$ to 3 inches thick, usually rubbed and bedded, and jointed in cement in regular squares. Entrance Halls are sometimes laid with polished Italian white and blue veined marble, in uniform squares one inch thick, with a border 6 inches wide, the whole bedded on coarse York paving. *Rubble causeway* is a cheap paving, the stones being only hammer-dressed; in *ashlar causeway* they are jointed and fitted, about 8 to 12 inches long, 5 to 7 wide, and 12 deep.

Stables may be paved with Aberdeen granite paving, dressed and sorted, 8 inches deep and 5 wide at top and bottom and laid to a current on a 4 inch layer of good rough gravel, the whole of the paving well rammed. and run with stone lime and river sand grouting.

Hinge and hook stones to doors of vaults, etc. may be 1′ 6″ cube, rebated for door and sunk for hooks of hinges, to be run with lead. Rebated stones to be provided to receive bolts of locking bars, each 1 foot cube, built into jambs; or hinge stone may be 12″ $\times$ 9″ $\times$ 6″ tooled, rebated, and rounded on the corners, including letting in and running with lead to flanges of hinges; the lock or latch stones to be also 12″ $\times$ 9″ $\times$ 6″, tooled, rebated, and rounded three corners, including letting in and running with lead to staples. Where *iron girders* are used, pieces of granite street curb are to be placed under the ends. Under columns of *iron*, put 4″ York landing about 2 to 3 feet square, and bed thereon a granite base, 18″ square by 15″ high, with stub hole sunk on the top for column. Where *chimneys project*, stone corbels are sometimes used, and they must be described of a sufficient size safely to carry the weight. $2^1/_2$″ tooled York, the edges squared, with 9″ cramps run with cement, will be a good *bond* for ashlar facing.

Copper chain bars, cast with projections or stubs on the underside, so that two may let into every stone, are sometimes used to strengthen architraves, being let flush into them.

Copings are from 2 to 3 inches thick, of various widths, weathered and quarryworked, or tooled and throated both edges, and set in mortar or cement. The joints are best joggled with slate or hard stone. Coping for gables may be 3″ thick, with splayed tops and rebated joints, chamfered or moulded one or both edges, or simply throated. Fix solid saddle stone on apex and knee stones at ends, tied in with iron cramps, $1^1/_4$″ $\times$ $^5/_8$″, turned up and down at ends.

Curbs are of varied sizes, rounded or square on top edge, and tooled or rubbed. The joints are plugged or joggled with slate, stone, or iron, and run with lead or set in cement. Holes are cut for rails, or rebates are made for iron gratings, as the case may be. T stones for stay bars are to be provided.

Sills must not be less than $2^1/_2 \times 7$ inches. They are tooled or rubbed, and are weathered and throated, and should be 4 inches longer than the openings, and project, at least, $1^1/_2$″ beyond the face of wall. The sills, heads, and stone jambs to *doors of strong rooms* should be of tooled York, at least 9 inches thick, properly rebated, with toothings, mortices, etc.

Sinks are usually from 5 to 8 inches thick, tooled or rubbed, dished out, mitred, perforated and rebated for grating, run with lead. The corners are rounded, and the sink usually cut and pinned into the wall. A sink 7 inches thick may be sunk $4^1/_2$ inches.

Slabs and *back hearths* are from 1″ to $2^1/_2$″ thick; back hearths are to be of York, tooled or rubbed, and the slabs in front of the inner hearths of Portland or marble, 18 to 20 inches wide.

Chimney Pieces. The commonest are plain York, rubbed, cramped, and set with tooled slabs and rough back hearths. The most ordinary Portland have inch jambs, mantles, and slabs, rubbed, with the necessary York bond stones, linings, and blockings; then the boxed and moulded are more expensive. One inch is the best thickness for the stones, and 6 inches the narrowest width that should be described.

Statuary, and veined marble chimney pieces have usually a price specified, including slabs, carriage, and fixing, varying from £2 upwards.

Baths are sometimes of veined marble, rendered water-proof by setting in Dutch terras, plugged and cramped with copper at the joints, with marble step round two sides, and holes cut for laying on the water. Slate is of course a cheaper material, and, if enamelled, very appropriate.

DESIGN FOR A PAIR OF EIGHT ROOMED HOUSES.

Plates 121. 122.

The accommodation in these houses consists on the Basement of a Kitchen, Scullery, Coal cellar and Wine cellar, W. C., Pantry, Larder, Store, and Housemaid's closet, with stairs in area for Tradesmen, and to Garden at back; on the Ground Plan, Entrance hall, Hall, Drawing and Dining rooms, and W. C.; and the Chamber Plans have each two Bed and two Dressing or other rooms, W. C., and Closets. The dimensions are all given and admit of course, in all designs, of being increased or diminished according to different tastes and demands. If the principal fronts are faced with second malms and cement, the cost of the two houses will average £1800.

DESIGNS FOR SCHOOLS AND RESIDENCES.

Plates 123. 124. 125.

This Design comprises two spacious, well-lighted School rooms for Boys and Girls, each 50 by 20 feet, and separate residences for the Master and Mistress. There is an Entrance porch to each School room, and Play yards, W. C. and Urinals are attached to them. The School rooms will probably be warmed by means of stoves, and ventilated from the roof, which is of open timber construction, as best adapted to the purpose, and securing the greatest possible amount of height. The Residences have each a Parlour, Kitchen, Pantry, Coal cellar, W. C., and Dust place; and on the Chamber floor three Bed rooms. The style is a modified species of Romanesque, chosen as more expressive of the purport of the buildings than perhaps others are. Red bricks with some black hearders and a few dressings of Bath stone are proposed for the Elevations. The open roofs are to be of fir, stained light oak colour, which may be done very cheaply. Erected thus, the cost of the buildings will probably be £2100.

DESIGN FOR A ROW OF NINE ROOMED HOUSES.

Plates 126. 127.

Plate 127 forms our last Illustration of continuous Street Architecture, of which we have given several examples; cement and second malms are proposed as the facing materials. On the Basement are Kitchen and Scullery, with ample domestic offices. The Ground floor has Dining and Breakfast rooms, with steps leading to the garden, W. C., etc. On the first floor is the Drawing room and a Bed room; and on the Second floor, two Bed rooms and one Dressing room. The estimated cost for two of these houses is £1450.

DESIGN FOR A SHOP FRONT.

PLATE 128.

This front is to be executed with brick piers and a wood breastsummer, the whole covered on the exterior with Portland cement, 3 sand to 2 cement. The enrichments are to be in cement and the figures in the panels painted. Counters and cases are shown on the plan. The plate glass may be in two or three pieces. Erected thus, the cost of the front will average £130.

DESIGN FOR A DETACHED VILLA.

PLATES 129. 130.

This Villa has on the Basement, Kitchen, Scullery, Servants' hall, Footman's room, Stores, Pantry, Wine cellar, Housemaid's closet, with Area at the back communicating with Cellars for cleaning knives, boots, etc., for beer, coals, and a W. C. On the Ground level are Drawing and Secondary Drawing rooms, Dining and Morning rooms, Entrance passage, Hall and W. C. On the first floor are four Bed rooms, one Dressing room, and W. C.; and on the second floor three small Bed rooms. The effect of the Elevation is considerably increased by the difference of levels, and the cost of this house, if erected of stock bricks with second malm and cement facings, will not exceed £1100.

DESIGN FOR A DETACHED TOWN HOUSE.

PLATES 131. 132.

There is no Basement to this residence. The Ground floor contains Drawing, Dining, and Breakfast rooms, Kitchen, Scullery, W. C., Pantry, and Coal cellar. The first floor has five Bed and two Dressing rooms, Closet and W. C., and the second floor five Bed rooms and one Dressing room. Both this and the previously described design will be found most convenient residences for large families, with also some pretension to architectural effect. The cost of this Town house, faced with cement and red bricks, will be £1250.

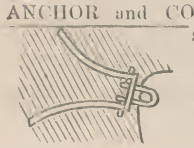
GLOSSARY OF TECHNICAL TERMS USED IN BUILDING.

The following Glossary contains only those technical terms which the reader will most probably require to have explained. Such words as Arch, Carpentry, Joinery, Masonry, etc. are omitted, as whole articles have been devoted to their elucidation; and when a word in common use is left out, it will be found to have been previously defined under its appropriate heading; such as Floor, Roof, Partition, Girder, Tie-beam, etc.

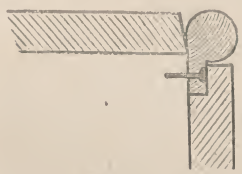
ABACUS. The topmost member of the capital of a column, crowning both the capital and column.

ABUTTING JOINT. That jointure of two pieces of wood in which the fibres of one piece are perpendicular, or nearly so, to the joint, and those of the other piece parallel to it; as the foot of a rafter abutting on a tie-beam.

ANCHOR and COLLAR, or GATE HINGES are as shown.



ANGLE, or STAFF BEAD. A bead with a section of about three-quarters of a circle, with a projection on one side, by which it is fastened. It is used to protect plastered angles in rooms, but, in superior finishing, the plaster should be well guaged and brought to a fine arris.



ANGLE BRACES or TIES. Pieces of timber used to strengthen the angle formed at the extremities of two pieces of timber, as wall plates, well-holes of stairs, etc. They are much used at the angles of the wall plates of roofs; the cross piece being the *angle tie,* and that from the angle meeting this, the *dragon-piece.*

APRON, or PITCHING PIECE. In Plumbery, the flashing. In staircases, the horizontal piece of timber, carrying the carriage pieces, or rough strings, and also the ends of the joists forming the half paces, landings, etc.: it is firmly wedged into the walls. The *apron lining* is the facing to it.

ARCHITRAVE. The wood finishing round doors and windows. The lowest of the three divisions of an entablature.

ARCHIVOLT. The moulding on the face of an arch.

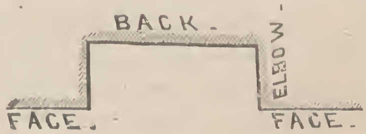
ARRIS. The angle of junction of two surfaces. An *arris fillet* is a triangular slip of wood used to raise slates next chimney, etc.: when at the eaves, it is called *eaves board* or *lath.*

ASHLARING. Upright quartering in garrets, between the rafters and floor. *Ashlar,* in masonry, is hewn, in contradistinction to unhewn or *rubble* work.

ASTRAGAL. A semicircular moulding.

ATTIC. The topmost story or room.

BACK. In a recess the *back, face,* and *elbows* are thus; the backs and elbows of windows being the inner parts below the sill. The upper part of timbers and handrails is the *back,* and the lower the *breast.*



The *back of a stone* is the inner part opposite the face. *Backing* a rafter or rib, is making its upper surface parallel with the others. The *backing of a wall* is the filling in of it as opposed to the facing.

BALECTION or BOLECTION MOULDINGS project beyond the surface of the framing.

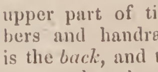
BARGE BOARDS are those on the outer face of gables, hiding the horizontal timbers and rafters.

BAT. A term applied to portions less than one half of a brick.

BATTENING. *Stuff* (usually 2" >< —") fixed to walls and rafters to receive laths. To walls they are fastened to equidistant *bond timber* or *plugging,* from 12 to 14 inches from centre to centre in the length of the battens. *Quarterings* are substituted for battens in great irregularities in rooms.

BATTER. A term used to express the leaning in from a vertical position of a retaining or breast wall, either straight or curved; if it leans forward it *overhangs.*

BEAD BUTT is when the penals of doors have vertical beads without other mouldings; *Bead flush* is when the beads continue all round the panel, although in both cases they are flush, or even with the face of the surface. *Quirks* to beads are sinkings thus, either *single* or *double.* *Bead butt and square or moulded* is applied to the *two* sides of framing, which may also be *bead butt,* or *bead flush* both sides.



BED of a slate, the underside. The lower surface of a stone is called its *underbed,* and the upper its *upperbed.*

BEVEL. A sloped surface, which if applied to openings for the purpose of enlarging them is termed a *splay.* *Cant* and *chamfer* are also words applied to the cutting off an arris or angle; in the latter the angle is usually taken off equally on both sides. Splay is the more appropriate name for large bevels, cants, or chamfers.

BIRDS MOUTH or SALLY. An interior angle at the end of a piece of timber to form a resting surface; also angles in brickwork, etc.

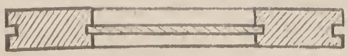
BLOCKED and GLUED is a mode of securing angles of woodwork, as in the diagram. The *staves* of wood columns are glued up successively with blockings; also the treads and risers of stairs, etc.

BOARD. A piece of timber not above $2\frac{1}{2}$ inches thick, but more than 4 broad.

Planks, exceed $1\frac{1}{2}$ inches in thickness and 9 in width; they are generally 11×3 inches.

Deals are $9'' \times 3''$; when sawn in two thicknesses they are *whole deals*, or $1\frac{1}{4}''$ thick generally; those $\frac{1}{2}''$ thick are *slit deals;* when divided in five, *five cut stuff.*

Battens are 7 inches wide; those 5 inches are best for flooring, etc. *Lear boards* are used in gutters to prevent the lead work sinking between the rafters: *valley boards* are those fixed for the same reason on valleys of roofs. *Board and brace framing* is thus,



BOASTING. Working stones with a broad chisel not in uniform lines. The roughing out of a carving.

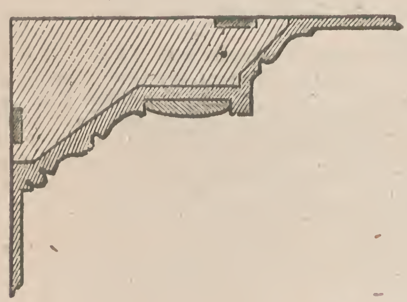
BOND. The mode of laying, or tie of bricks and stones; also applied to timber and iron built into walls to strengthen them. *Chain bond* expresses the tiers of timber for this purpose, and to attach the finishings.

BONEING. Judging of the continuity of surfaces or lines by the eye; also ascertaining whether work is out of *winding* by straight edges.

BOULDER WALLS of rounded flints and pebbles in mortar; paving the same.

BOXINGS of windows are the *cases* into which the shutters are folded.

BRACKETING. The vertical ribs fixed to ceilings and



walls to carry cornices. They save plaster in mouldings and are used, cut roughly to the profile of the cornice, about 12 inches apart and at the angles; laths are nailed to them.

BREAKING JOINT is coursing bricks or stones so that the joints may fall over solids.

BREAST. See *Back.* The projecting facing part of a chimney towards a room is the breast, over the front of the fireplace. The *breast of a window* is the part forming the back under the sill.

BREASTSUMMER. A beam or lintel over a wide opening, carrying a weight above; as to shop-fronts.

BRIDGE or NOTCH BOARD is the board on which the ends of the steps of stairs are fastened.

BUILDING BEAMS is scarfing, bolting, or strapping several pieces of timber together.

BULL'S NOSE. A name applied to external obtuse angles.

BULLEN NAILS with round heads and short shanks lacquered; used to the hangings of rooms.

BUT-HINGES. The ordinary hinges to doors, etc.

BUTMENT CHEEKS. The solid parts on each side of a mortise, the thickness of which is usually equal to that of the mortise.

CAMBER. An arch or curve on the top of an aperture or beam. The *camber slip* is a piece of timber used by bricklayers, about $\frac{1}{2}$ an inch thick, rising about 1 inch in 6 feet, for drawing the soffite lines of straight arches; and with sometimes another curve, rising only one half of the above, for drawing the upper portion of the arch, so as to prevent its be-becoming hollow in the setting: the upper line of the arch is, however, often preferred straight.

CARRIAGE. The framed timber work of wood stairs, supporting the steps.

CASING. The outside covering; as *lining* is the covering of the interior surface of a body.

CASEMENT. A sash hung on hinges, in contra-distinction to one hung on weights.

CATENARY or CATENARIAN CURVE. The curved line formed by a chain or cord hung freely from two points: it is considered the proper curve of equilibrium for arches.

CAULKING, COCKING or COGGING. The notching of a tie or other beam on to the plate.

CESSPOOL. A sunk space enclosed in brickwork to receive the sediment in drains; it is made accessible for cleansing.

CHASE. An indent cut into one wall to receive another.

CHIMNEY. The *fireplace* is the open part; the stone under the *hearth;* that in front, the *slab;* the sides of the opening, the *jambs;* the head of the front part resting on the jambs, the *mantle;* the passage for smoke to the top of the room, the *funnel;* that part which contracts, the *gathering*, or the *gathering of the wings;* the passage to the top of the chimney, the *flue;* the portion connecting the gathering with the flue, the *throat;* the divisions between flues, the *withes*; several chimnies together form a *stack*; and the *shaft* is the part, rising above the roof. (See Breast and Back.)

CLAMPING is fixing two pieces of wood with a *mortise and tenon*, or *groove and tongue*, with the fibres crossing.

CLEFTS. The fissures in unseasoned wood, often filled with a mixture of gum and sawdust.

CLINCHING is bending and driving backward the ends of nails showing through wood.

CLINKERS the best burnt bricks impregnated with nitre.

CLOSER. The last stone in a course, of less size than the others, and bad in bond. The last also in brick bond; a *king closer* is a three quarter, and a *queen*, a quarter brick.

CLOSET. A small enclosure, and the correct substitution for *cupboard:* we might as well say *Teaboard* or *Sugarboard* as *Cupboard.*

COB-WALLS formed of mud and straw; many in Somersetshire are observed to have lasted a surprising time.

COMPASS BRICKS are circular, for *steining* wells, etc.

COPING. The covering of a wall. *Feather edged* is splayed to throw off the water; *saddle backed* is thickest in the middle.

CORDON. The edge of a stone outside a building.

CORE. The inner part of any body.

COUNTER GAUGE. The transferring of a measure; as that of a mortise to a tenon.

COUNTERSUNK is a cavity sunk to receive a projection.

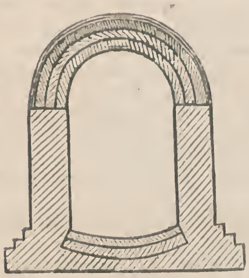
COUSINET or CUSHION. The impost stone for receiving the first stone of an arch; its bed is level below and the upper bed inclined.

CRADLING. Centering for *culverts*, etc.; also the timber ribs for the plastering of ceilings and those for shop entablatures.

CREASING. Tiles under the topmost course of a brick wall, projecting about an inch on each side to throw off the rain.

CROSS-GRAINED STUFF. Wood with fibres twisted and, consequently, difficult to plane.

CULVERT. A sewer under a road with an *insisting* arch above and an *inverted* one below, as in the margin.



CURB. An edging of brick, stone, or wood used for the purpose of protecting or confining something.

CUSHION or **AUXILLIARY RAFTERS** are placed beneath, and parallel to the *principals*, for the purpose of increased strength.

DADO. The wood lining, about three feet high, to rooms.

DOG-LEGGED STAIRS have no well-hole.

DORMER or **ATTIC.** A window in and perpendicular to the roof.

DOVETAIL. So called from its spreading like a dove's tail; the strongest connecting form of joint *(See diagrams,* Art. *Joinery)* used by Joiners and Masons.

DRAGON-PIECE. See *Angle Braces.*

DRESSINGS. Ornamental mouldings, etc.

DUBBING-OUT is the bringing out fair an uneven surface for plastering.

ELBOWS. See *Backs.*

ENGLISH BOND. In Brickwork, where the courses are alternately all *headers* or *stretchers;* in Flemish bond, *headers* and *stretchers* alternate in each course. The first is the strongest, the second being considered the neatest in appearance.

FALLING MOULDS are the two moulds applied to the vertical sides of handrails of stairs, one to the convex, the other to the concave, to finish the squaring and form the back and under part of the rail.

FEATHER-EDGING is thinning one edge of a material.

FIR IN BOND, or *no labour,* denotes timber without framing, as bond, lintels, etc.; *fir-framed* is unplaned, rough framing, as rafters, joists, etc.; *fir-wrought,* that which is planed; *Fir rebated, beaded,* etc. includes the several operations as technically phrased.

FLASHINGS. The metal laps and coverings to ridges, hips, and the edges of work rising above roofs.

FLATTING. Painting to interior work finished without gloss. (See Art. *Painting.)*

FLOATING. The smoothing coat of plastering. (See Art. *Plastering.)*

FLUSHING. The splintering or flakeing of the edges of stones from unequal settlement. Clearing drains with water.

FRANKING. The notching of a sash bar to mitre with the transverse bar.

FROSTED. Stonework made to appear congelated like ice in irregular drops.

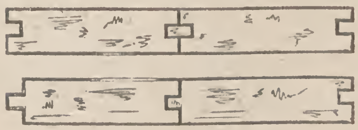
FURRING. Nailing thin slips of wood, or *furrs,* on timber to produce a level surface.

GAGE or **GAUGE.** An instrument for drawing a parallel line. A measure or distance; as the length of a tile or slate below the lap, or uncovered by the course above. Also an addition of plaster of Paris to common plaster for cornices ceilings and walls; this causes the plaster to dry quicker, and is often added to all the plaster to gain time.

GEOMETRICAL STAIRCASE. One in which the steps are carried at one end by the wall.

GROUNDS. Wood fixed to walls and flush, with the plastering to attach the finishings, and nailed to the *plugging* or *bond.* A *groove* or *rebate,* into which the plaster is run, forms a key which prevents it from shrinking and showing a crack. The skirtings of rooms are fastened to *narrow grounds.* Grounds are also adopted over apertures to strengthen the plaster as well as fasten the finishings.

GROOVED and TONGUED. A method of connecting boards by means of *grooves* and *tongues* out of cross grained stuff or *feathering.* In *ploughed* and *tongued* work, the tongues are formed out of the stuff.



GROUTING. Thin mortar adapted for throwing over paving, but not to be recommended, although often used in addition to the ordinary mortar, for brick walls.

HACKING is a defective interruption of a course of stonework by another on a different level, owing to the want of stones of an uniform size.

HAMMER BEAM. A projecting beam at the base of a principal rafter acting somewhat as a tie, but not extending to the opposite wall.

HEADERS. Stones extending transversely across a wall, as *stretchers* extend in its length.

HIP. The angle timber at the junction of a roof, with a sloping instead of a gabled end, thence termed a hip roof. The *hip mould* is that by which the *back* of the hip rafter is formed.

HOARD. A temporary timber enclosure.

HOUSING. The space taken out of one body to insert another.

JACK TIMBER. Any timber shorter than the others with which it ranges.

JETTIE. An overhanging story or other part of a building.

JIB-DOOR. One continuous with the face of the wall.

JOGGLE. A joint to prevent two bodies sliding past one another. In masonry, stone, iron, or slate are used as in the margin. The struts of a roof are *joggled* into the principals, and sometimes into the king-post, then appropriately called a *joggle-post.*

KEY. A piece of wood let into another across the grain, either by dovetailing or grooving, as to a dado, to prevent warping. The *key of a floor* is the last board laid; that of an arch the highest stone.

KNEE. The convex part of a handrail, the *ramp* being concave. Any crooked piece of timber, or cut to an angle. A *knee rafter* is an angular one to which the others are fastened.

LACQUER. A yellow varnish used to brass.

LATH. Any thin strip of wood for slating, tiling, filleting, furring, etc. *Pantile laths* are square pieces. Laths for plastering are about an inch broad and three, four, and five feet long. There are *single, lath and half,* and *double fir laths,* the first less than a quarter-inch thick, the last half-inch. *Heart-laths* are used for roofs and exposed situations; *sap-laths* for plastering; those for ceilings thicker than for the walls. The joints must be broken, as improving the *key* for the plastering, and the ends must never be lapped upon one another. Oak laths are preferable for roofing.

LATHED, *laid, floated, set, coloured,* etc. (See Art. *Plastering.)*

LATH BRICKS are 22 inches long and 6 broad.

LEDGES. The transverse pieces of wood to which the vertical parts of common doors are nailed. The narrow stuff on the jambs and soffites of doors to stop them, in temporary work formed with fillets.

LEDGERS. The horizontal pieces of timber in scaffolding, parallel to the walls.

LEWIS. A contrivance fitted into a wedge-shaped hole in stones for raising them.

LINING. See *Casing.*

LISTED BOARDS have the sap wood removed from the edges, being thus reduced in width.

MALM or MARL STOCKS. The best description of stock bricks of an uniform yellow colour, technically called *firsts* or *cutters,* and principally used for arches. The *red cutting brick* is a superior description of the red stock. The *second best stocks* are called *seconds.* The *third quality of stocks* are *red* and *grey,* the former burnt in kilns. *Place bricks* are insufficiently burnt; *burrs* and *clinkers* overburnt. *Suffolk bricks* are of a light colour and close texture, rendering them very heavy. The Midland Counties bricks are the softest; those from Windsor and Stourbridge are fire bricks of a red colour.

MARQUETRY or PARQUETRY. Inlaid work for floors, etc.

MITRE. The line formed by the meeting of mouldings or other surfaces at an angle.

MORTISE. A sunk cutting to receive a projection or *tenon.*

MUNNION. The upright bars dividing the glass in a sash. *Mullions* separate the *compartments* of windows.

NAKED. A term applied to the main unfinished parts of work; also the plain surface of a wall.

NATURAL or QUARRY BEDS OF STONE. A term expressive of the position in which stone is found in the quarries with respect to the laminæ.

NEWEL. The central part of a staircase whether open or solid; also the wood posts, as the top and bottom of stairs.

NIDGED ASHLAR. Aberdeen Granite picked with a pointed hammer.

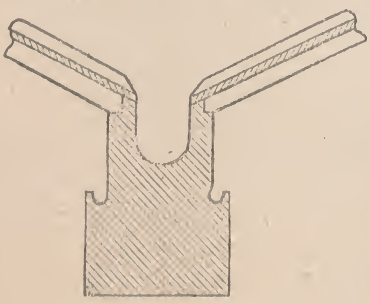
NOGGING. Quartering inserted in brickwork. *Nogging-pieces* are the horizontal boards about 2 feet apart worked in to strengthen the brickwork. *Nogs,* or *wood bricks* are used to attach the finishings.

NOSING of a step is the projecting part, generally rounded.

NOTCHED BOARD is one grooved or notched to receive the ends of steps.

OBLIQUE or SKEW ARCH. One in which the arch is formed aslant, or at an angle to the abutments.

PAXTON GUTTERS. An ingenious species of combined



support and gutter, with an inner channel to receive condensed moisture, invented by Sir Joseph Paxton, and suitable for conservatories. These gutter plates, as they are, must be adequately supported.

PENDENTIVE. The suspended body of a vault. *Pendentive Cradling* is the timber work for supporting the lath and plastering.

PERPEND STONE. One reaching entirely through the thickness of a wall.

PILES. Timber driven in loose soils to carry a superstructure.

PIN is a cylinder used for purposes of connection.

PINNING UP is driving wedges in the upper work in *underpinning,* to bring it to bear on that below.

PISE WALLING of stiff clay carried up in moulds or framework.

PITCHING PIECE. See *Apron Piece.*

PLACE BRICKS. See *Malms.*

PLANK. See *Board.*

PLATE. The horizontal piece of timber carrying framework.

PLOTTING. Delineating on paper the lines and angles of *plots,* or pieces of land.

PLUG or DOWEL. A description of vertical cramp for joining stones together. Also a piece of wood driven into a wall with the end sawn off; it is used to attach the finishings.

PLOUGHED and TONGUED. See *Grooved* and *Tongued.*

POINTING. The jointings of the external face of walls. *Flat joint pointing* is simply marking the courses with the edge of the trowel; *tuck pointing* is the introduction of fine plaster, pared to a neat parallel edge.

PRICK POST is an intermediate one between two principal posts to paling.

PRIMING. The first coat of painter's work. (See Art. *Painting.*)

PRINCIPALS. The main lowermost rafters of roof, in distinction to the *common rafters* above.

PUGGING. Coarse plaster laid on *sound boarding* to prevent the passage of noise; patent felt laid beneath floor boards is sometimes substituted for it.

PULLEY MORTISE or CHASE MORTISE. A *mortise* cut lengthwise in a piece of timber to receive a *tenon* in another. It is used to connect ceiling joists with binders.

PUNCHIONS. Upright pieces of timber in wood partitions, called also *studs* and *quarters.*

PUTLOGS. The horizontal pieces of timber in scaffolding, at right angles to the walls, let into holes in them, called *putlog holes.*

QUARTERING. Wood partitions, having *principal* or *double quarters* next doors, and, if trussed, forming the truss timbers, with *common,* or *single quarters,* or *punchions* between, together with *struts,* etc.; they are lathed and plastered or boarded.

QUOINS. Angle stones, whether external or internal.

RAKING. An incline to the horizon.

RAMP. See *Knee.*

RAMPANT ARCH. One whose springings are on different levels.

REBATE. A notch or rectangular sinking on the edge of a piece of wood to receive another, a bead being frequently run to hide it.

REINS OF A VAULT. The side walls sustaining it.

RESOLUTION OF FORCES. (See Art. *Mechanical Principles of Carpentry.*)

REVEALS. The vertical sides of window and door apertures between the face of the outer wall and the frames; the inner sides between the face of the wall and the frames being the *jambs.*

ROLLS. Pieces of wood placed to turn over sheets of covering metal where they join.

ROUGH CAST. (See Art. *Plastering.)*

RUSTIC WORK. The face of masonry left rough instead of being wrought smooth.

SAGGING. The bending downwards by its own weight of timber supported at the ends. A *camber*, or rise in the middle, will allow for this.

SALLY. A projection generally. The ends of a rafter, etc. cut with an interior angle.

SASH FRAME is that in which sashes are fitted.

SCANTLING. In carpentry a dimension in breadth and thickness; in masonry length, breadth, and thickness. A piece of wood under 5 inches square.

SCAPPLING is reducing stone to a surface without working it smooth.

SCARFING. Joining two pieces of timber endwise, so that they appear but one.

SCRIBING. Fitting a piece of wood edgewise to an irregular surface.

SETT OFF. An horizontal break, caused by a decrease in thickness.

SHINGLES. Small oak boards for covering roofs.

SHOE. The incline at the bottom of a pipe for turning the course of the water.

SHORE. A prop or oblique timber used to sustain a building. A *dead shore* is a vertical piece carrying a superstructure during repairs.

SHOOTING. Planeing straight the edge of a board out of winding.

SHOULDER OF A TENON is the plane from which it rises or projects.

SKEWBACK. The oblique line at the springing of an arch: it must be accurately cut, as the arch rests or abuts upon it.

SKIFFLING. The process of knocking away the rough projections of Kentish Rag stone at the time of quarrying: *knobbling* has a similar meaning as applied to other stones.

SOLDER. A composition used to join metals.

SOUND BOARDING. Short boards fixed horizontally between joists on fillets for supporting the *pugging* to prevent the passage of sound. Narrow boards are used with fillets three quarters of an inch thick by one inch wide, nailed at intervals of about a foot.

SPANDREL. The triangular space between the springing and top of an arch.

SPARS. A name given to common rafters.

SPLAY. See *Bevel. Flving* is used in the same sense.

SQUARE STAFF is an angle bead to make a good finish for papering.

SQUARING. Trying work by the *square;* — of a handrail, is cutting a plank to the form of the rail so that the vertical sections may be right angles.

STAFF BEAD. See *Angle Bead.*

STANDARDS. The upright timbers in scaffolding. Upright pieces to carry shelves, etc.

STAPLE. A loup to receive bolts, bars, etc.

STEINING, Brickwork laid dry to wells, etc.

STILTED ARCH. One of which the lines of the springing are continued vertically to the impost.

STORY POSTS. Vertical timbers carrying a wall above, with a beam over them.

STORY ROD. One used for setting the heights of steps.

STRAINING PIECES are placed between two opposite beams to prevent their approach.

STRIKING CENTERING is removing it.

STRING BOARDS are those next the well hole of stairs receiving the ends of the steps. When curved it is either got out of the solid or glued together in thicknesses.

STRUT or BRACE is an inclined piece of timber stiffening framing.

TAILING. The letting in of a bearing piece; *housing* is when the cavity is quite filled.

TEMPLET or TEMPLATE. A mould for the purpose of setting out work. A supporting piece.

TENON. See *Mortise.*

TONGUE. See *Grooved* and *Tongued.*

TOUCH-STONE. A name given to compact dark coloured marbles.

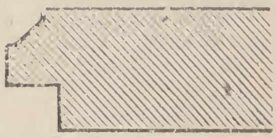
TRAMMEL. An instrument for drawing an ellipse.

TRIMMING. Fitting one piece of wood between two others; as a *trimmer* between two *trimming joists* to fire-places, stairs, etc.

TRUSS. A framework.

TURNING PIECE. A board with one circular edge for *turning* small flat arches.

TUSK. A bevel shoulder above a tenon to strengthen it where let into the girder.



UNDERPINNING. The bringing up of solid work under walls while they are supported by shores.

VALLEY. The junction of two inclined sides of a roof: the *valley piece*, or *rafter*, supports the *valley board* for the lead.

VENEER. Thin slips of superior wood on inferior.

VICE or VISE. A term applied to a spiral or winding staircase.

VOUSSOIRS are the wedge shaped stones of an arch.

WASHER. A flat piece of iron through which a bolt passes; being between the timber and the nut, it prevents the compression of the wood by the dragging inwards of the nut. Also the removeable metal plate to a sink.

WICKET. A small door in a large gate.

WITHE. See *Chimney.*

Printed by A. H. Payne, Reudnitz near Leipzig.

SUPERFICIES

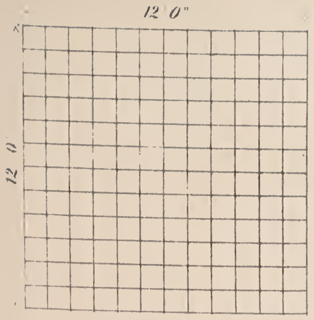
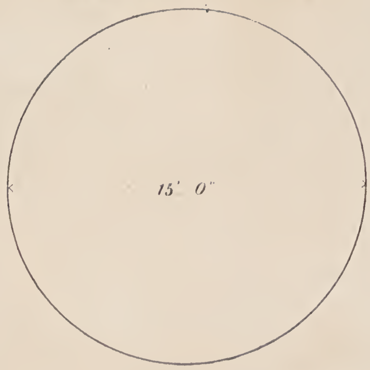


Fig. 1



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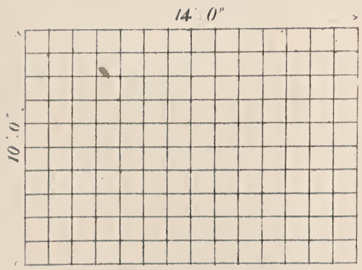
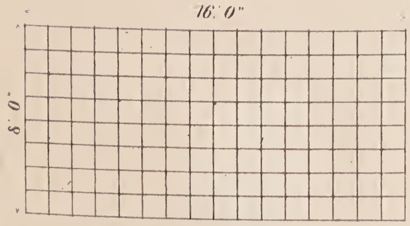


Fig. 3



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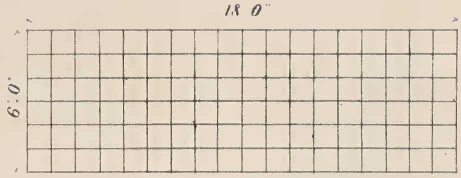

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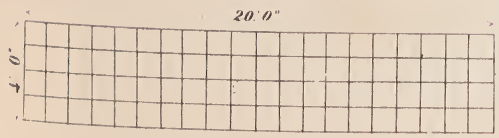

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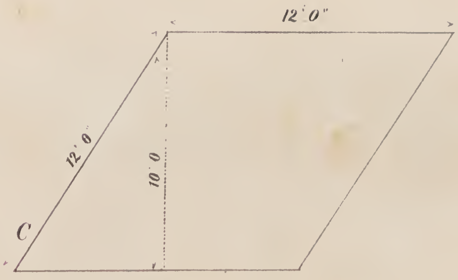

A Fig. 7

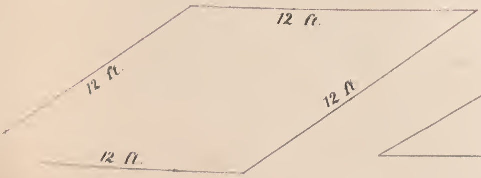

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

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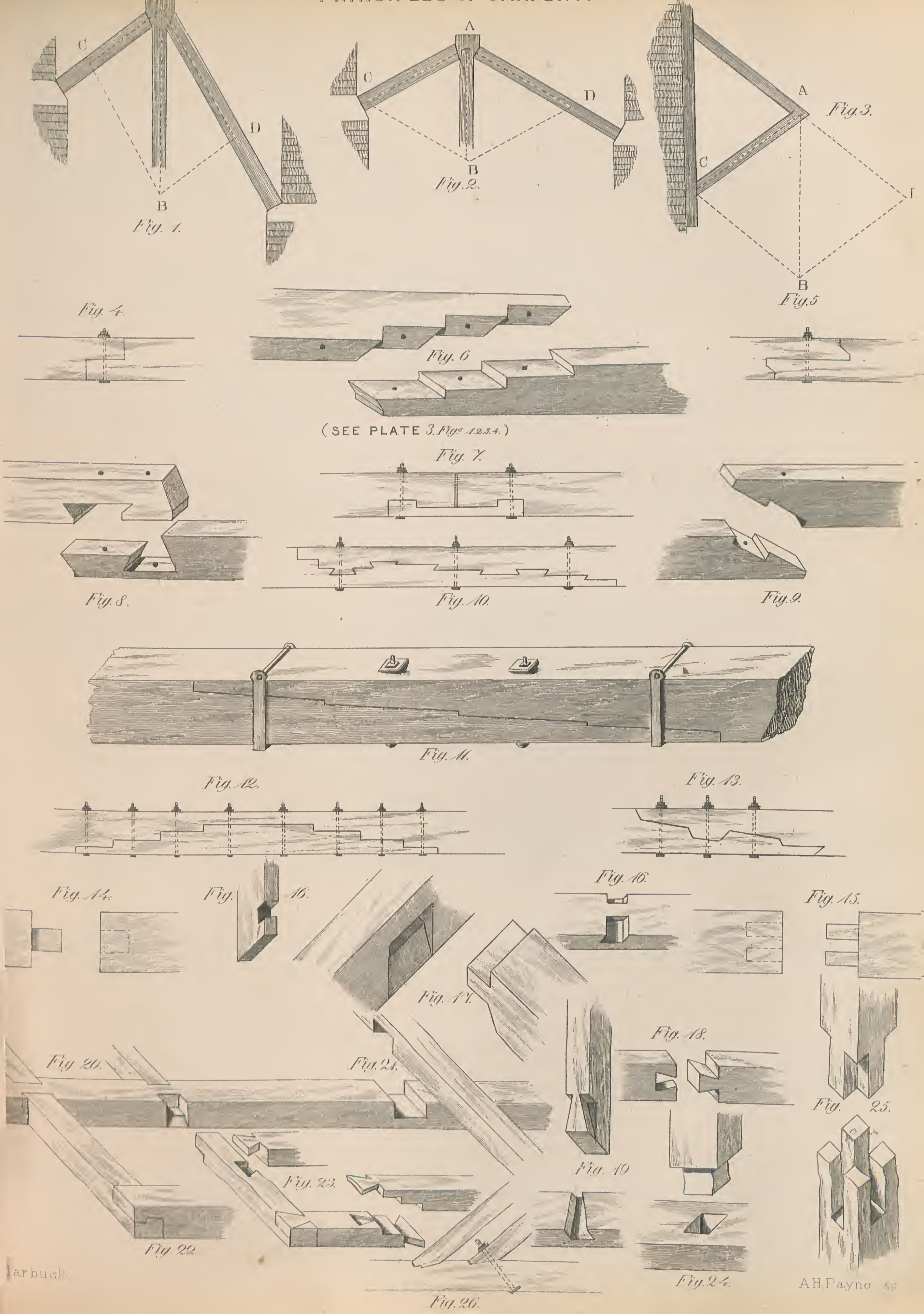
A. H. Payne sc.


C
A
B
D
Fig. 1.
Fig. 2.
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L
Fig. 5
Fig. 4.
Fig. 6
(SEE PLATE 3. Figs 1.2.3.4.)
Fig. 7.
Fig. 8.
Fig. 10.
Fig. 9.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 16.
Fig. 15.
Fig. 17.
Fig. 18.
Fig. 19
Fig. 20.
Fig. 21.
Fig. 22.
Fig. 23.
Fig. 24.
Fig. 25.
Fig. 26.
Tarbuck
A.H.Payne Sc.

CARPENTRY

Fig. 1

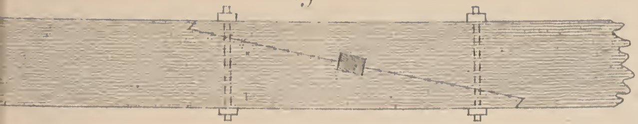
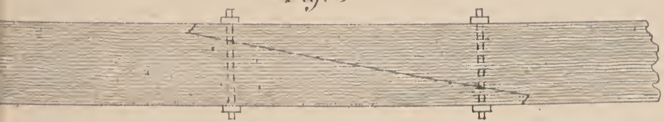


Fig. 2

Fig. 3



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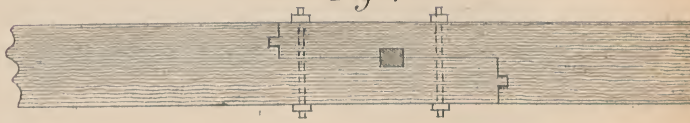
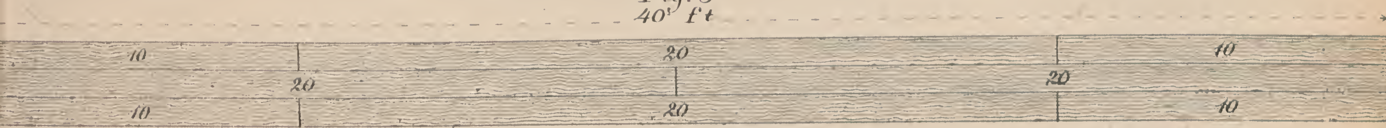


Fig. 5



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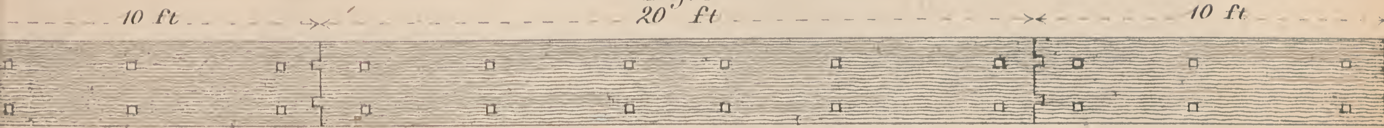

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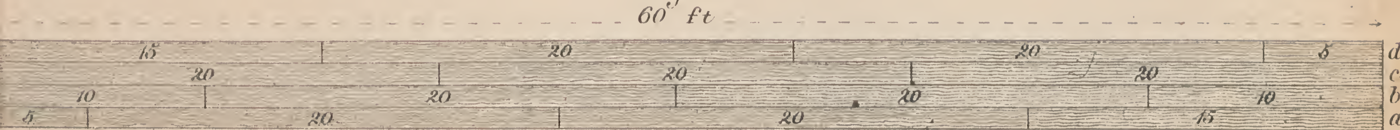
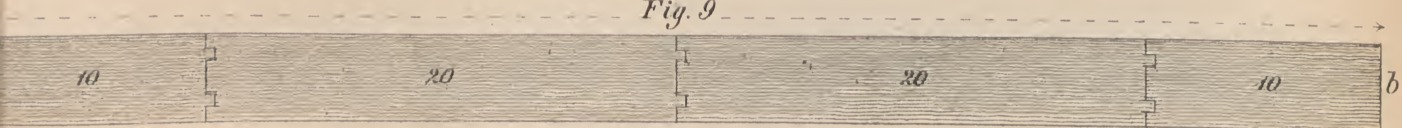


Fig. 8

Fig. 9



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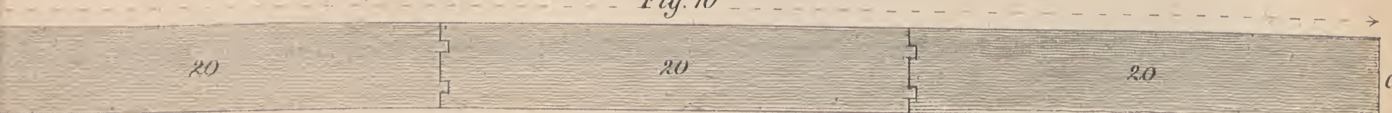

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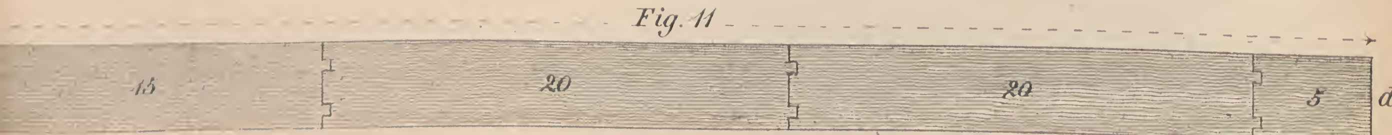

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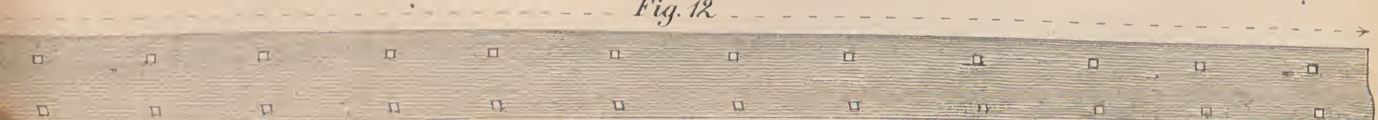


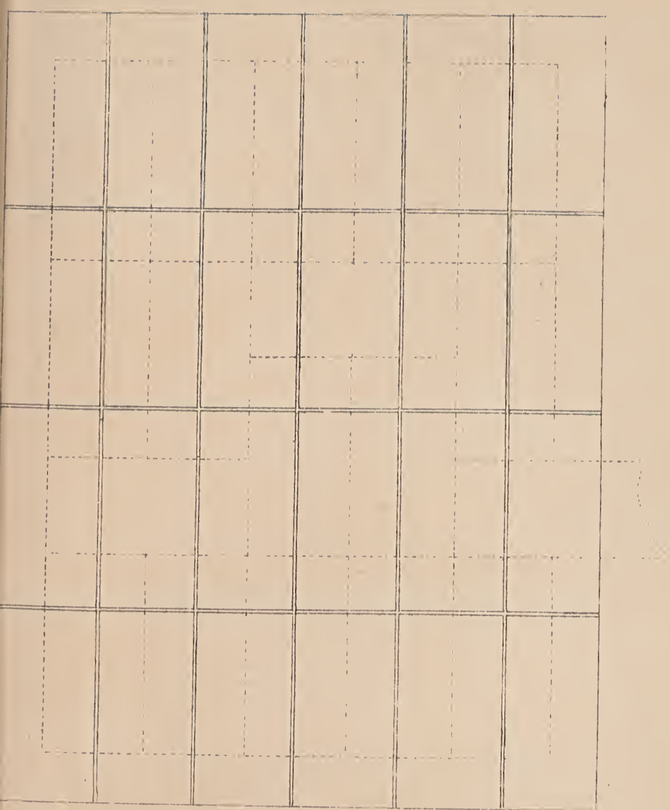
Gardner.

A.H.Payne sc.

WINDOWS WITH FOLDING AND LIFTING SHUTTERS.

ENLARGED DETAILS OF WINDOWS PLATE 4.

SCALES ONE QUARTER & FULL SIZE.



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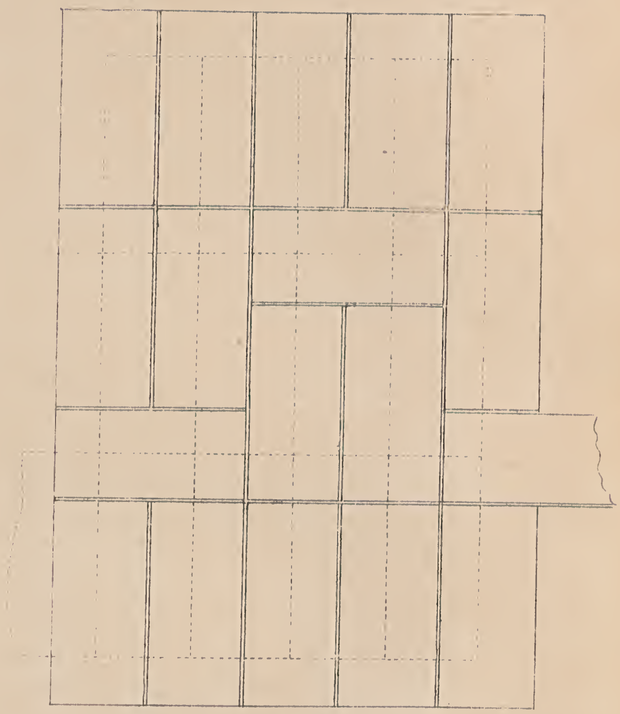


Fig. 2.

Fig. 3.

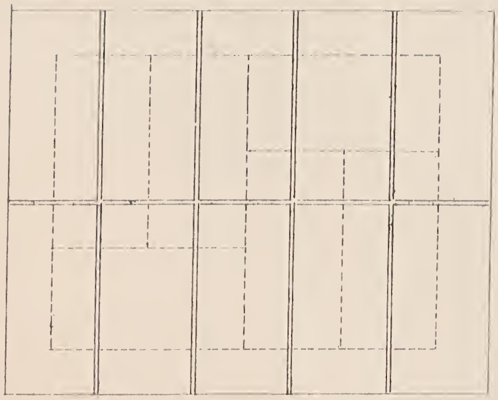
Fig. 4.

ardner & Son.

A.H. Payne sc.

BRICKWORK FOOTINGS

Fig. 5.



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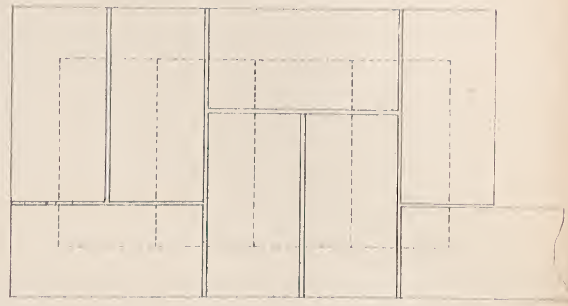
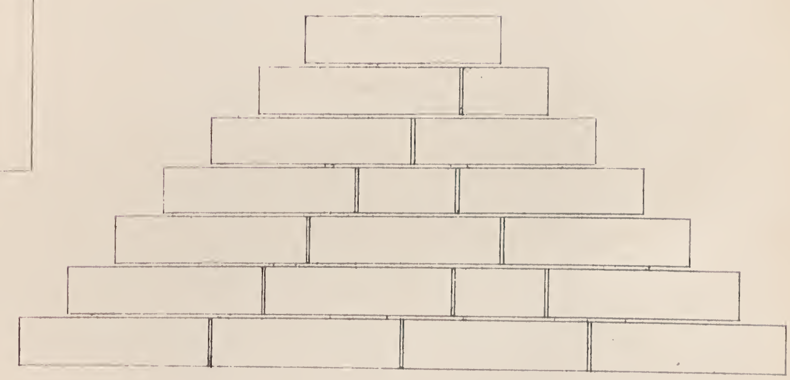


Fig. 7.

Fig. 8.



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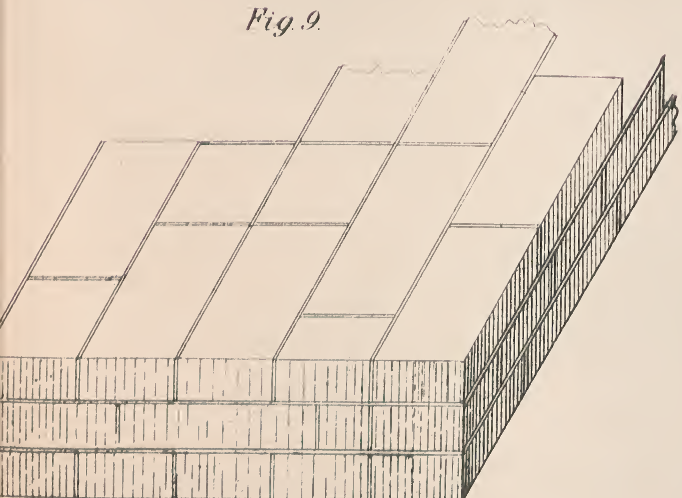
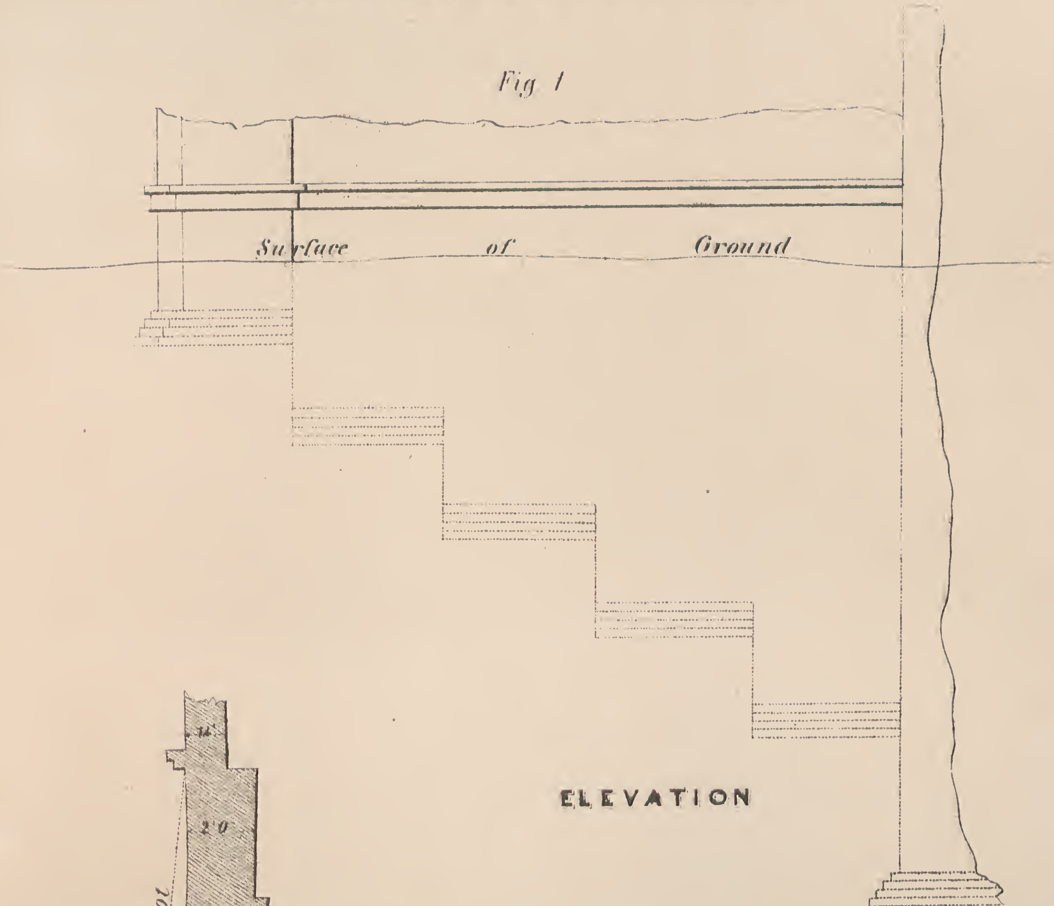


Fig. 10.

A. H. Payne sc.

SUSTAINING & WING WALLS

Fig. 1



ELEVATION

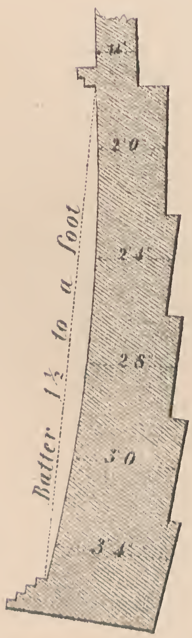
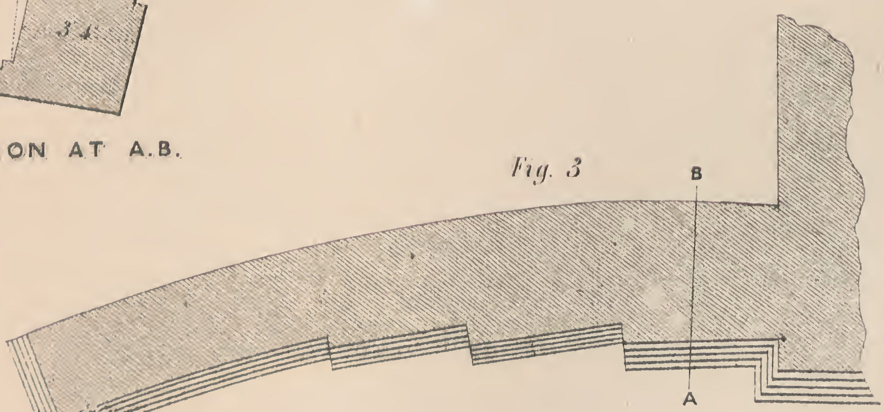


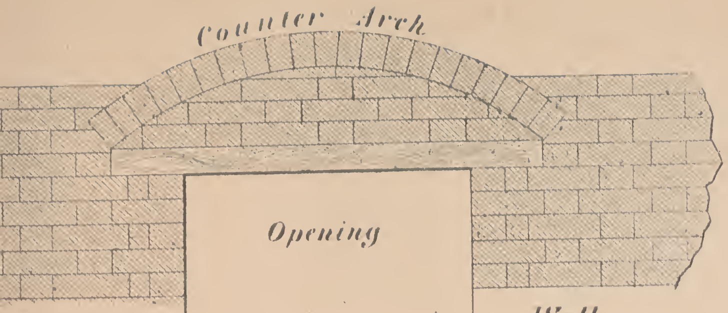
Fig. 2

SECTION AT A.B.

Fig. 3



PLAN OF FOUNDATIONS



Inside of Wall

Fig. 2

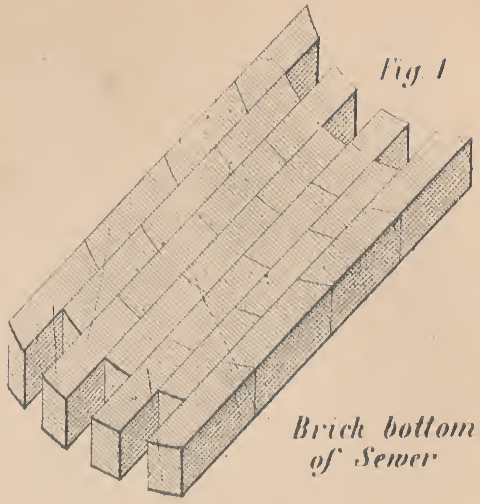


Fig. 1

Fig 3

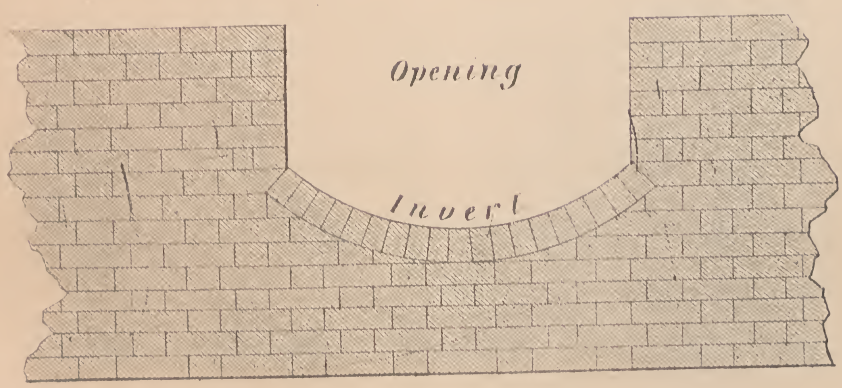
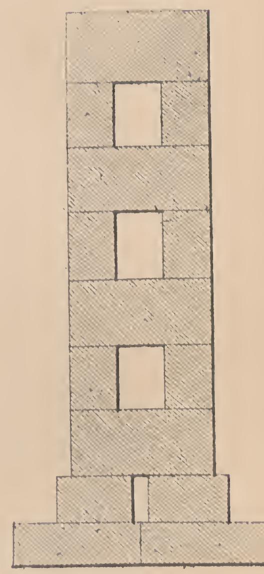


Fig 5



Hollow Walls Brick on Edge

Flemish Bond

Fig 4

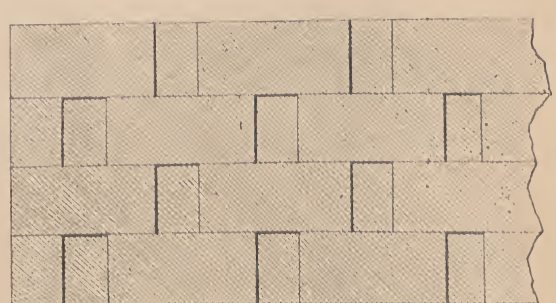
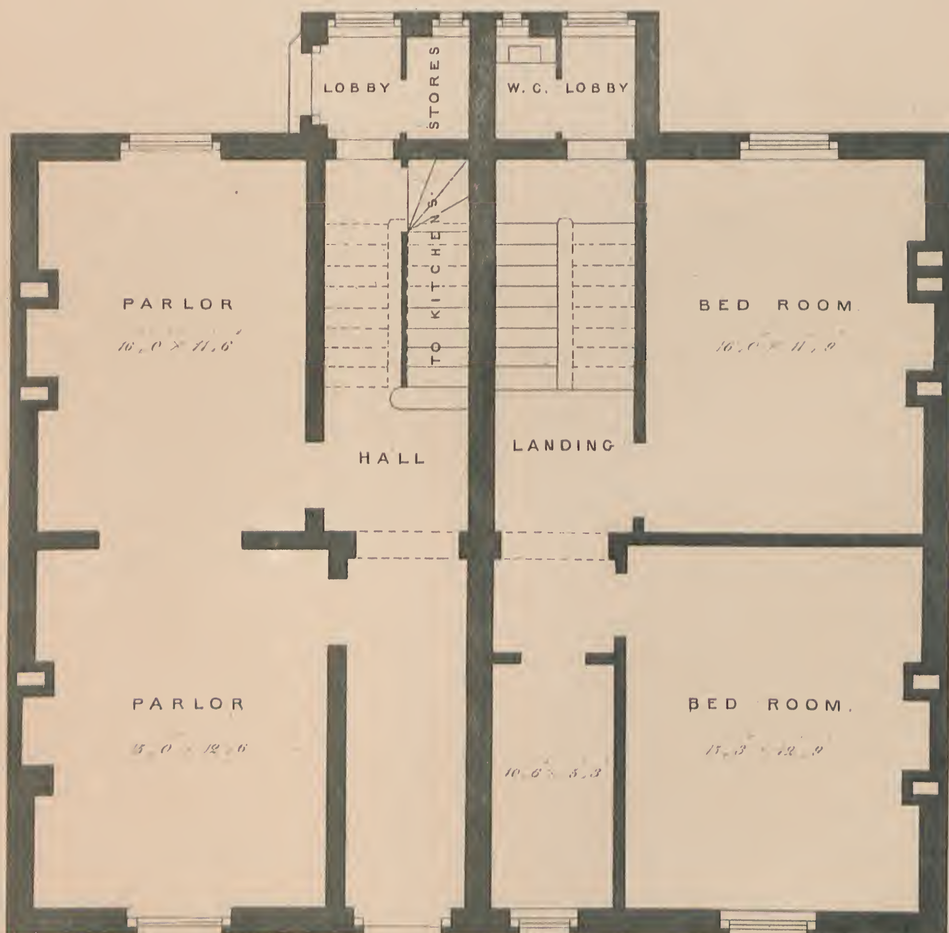


Fig 6

Design for a Pair of Seven Roomed Houses.

FRONT ELEVATION



GROUND PLAN.

CHAMBER PLAN.

SCALE OF 10 5 0 10 FEET

TRAPPING OF CLOSETS AND DRAINS

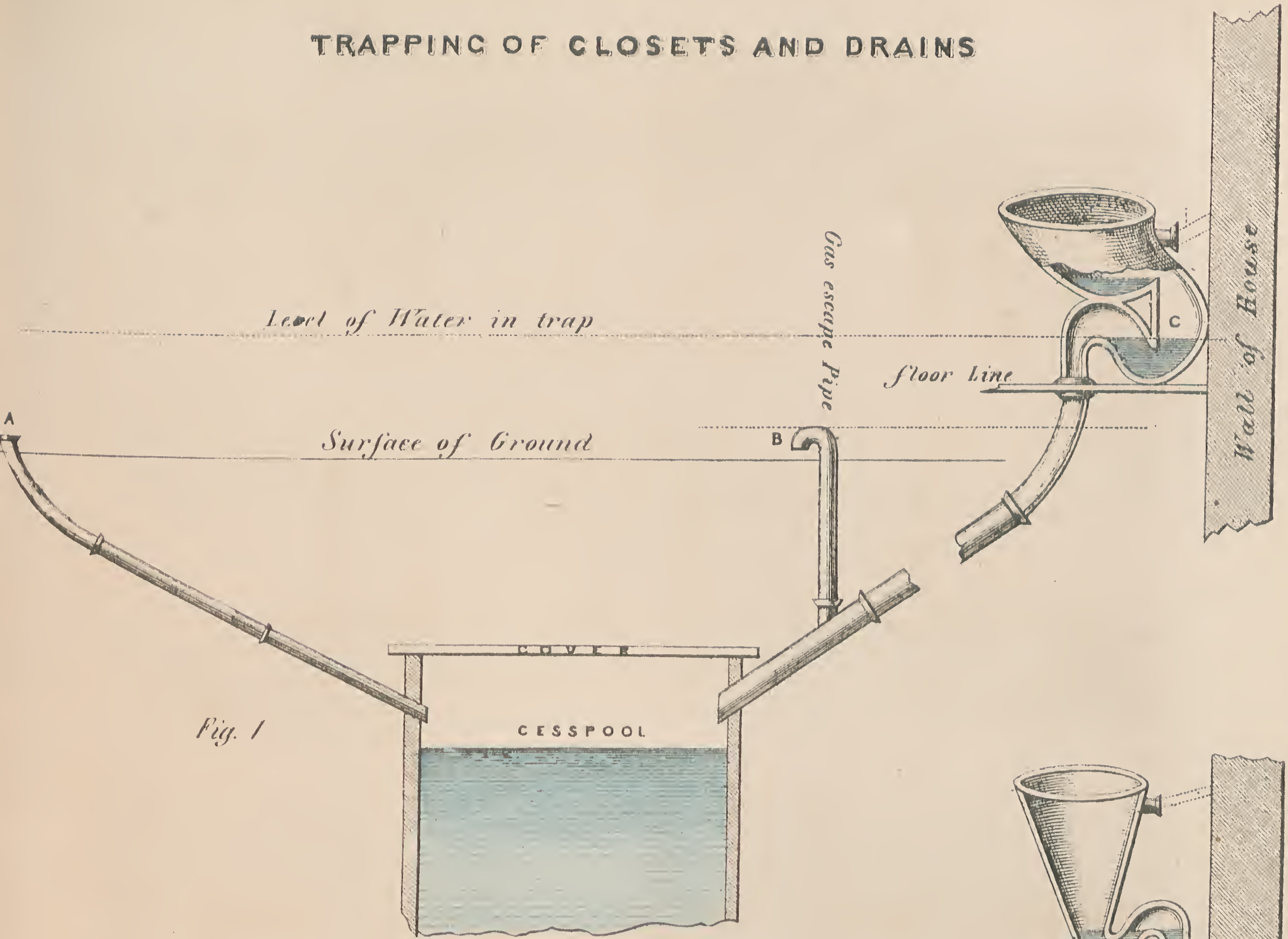
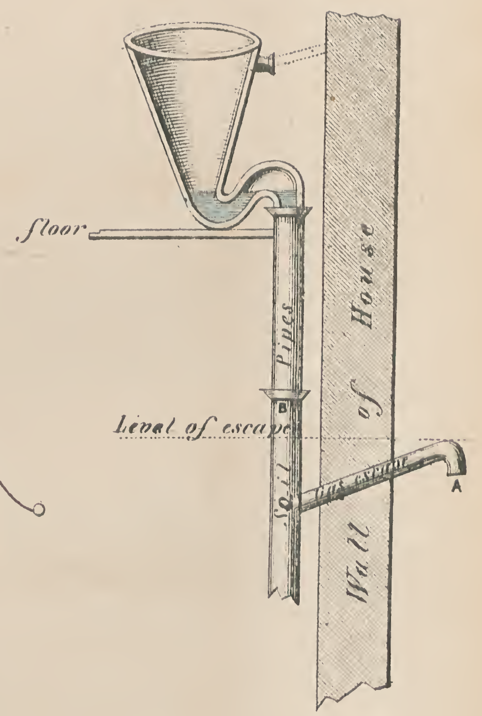


Fig. 1



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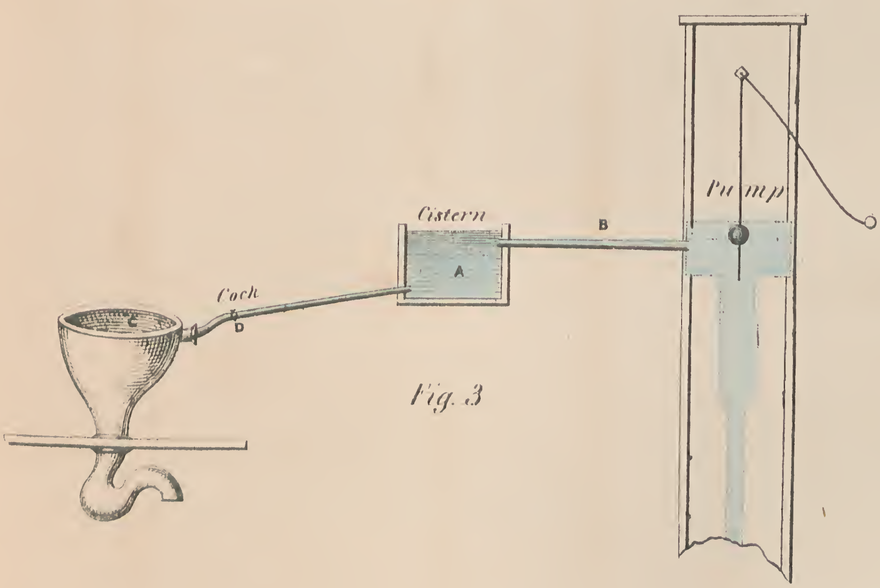


Fig. 3

A.H. Payne sc.

ADAPTATION OF TIMBER

Fig. 1

Fig. 2

Fig. 3

Fig. 4

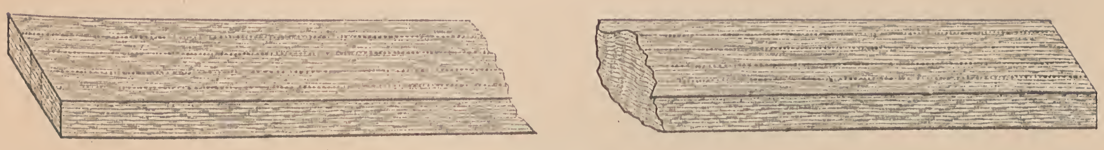


Fig. 5

Fig. 6

Fig. 7

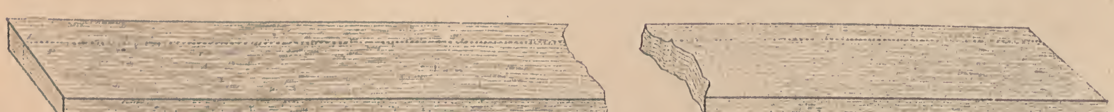


Fig. 8

rdner & Son A.H. Payne sc.

TIMBER FRAMING

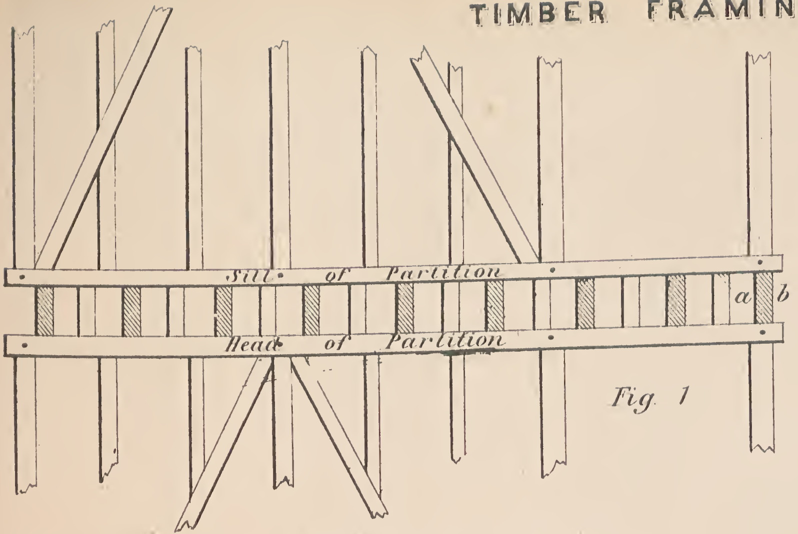


Fig. 1

Fig. 6

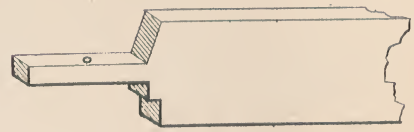
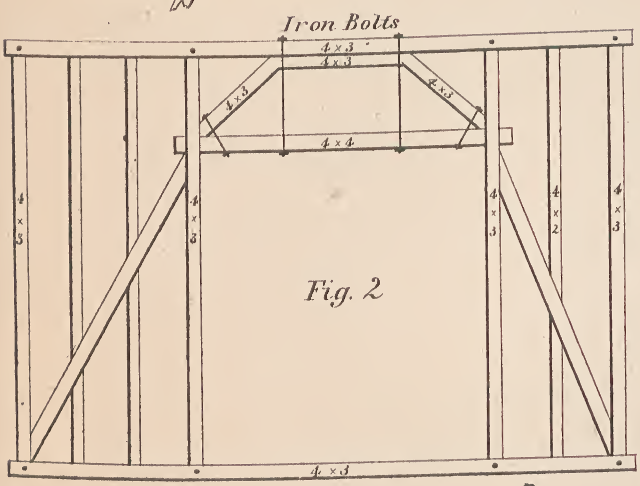


Fig. 7



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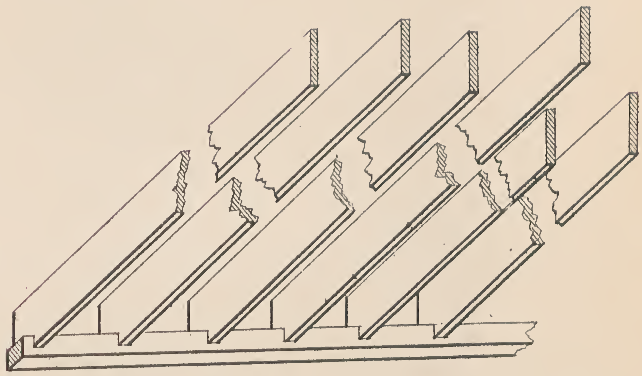


Fig. 5

Fig. 3

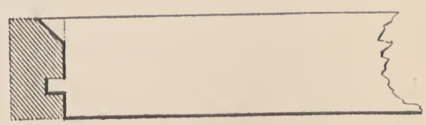


Fig. 8

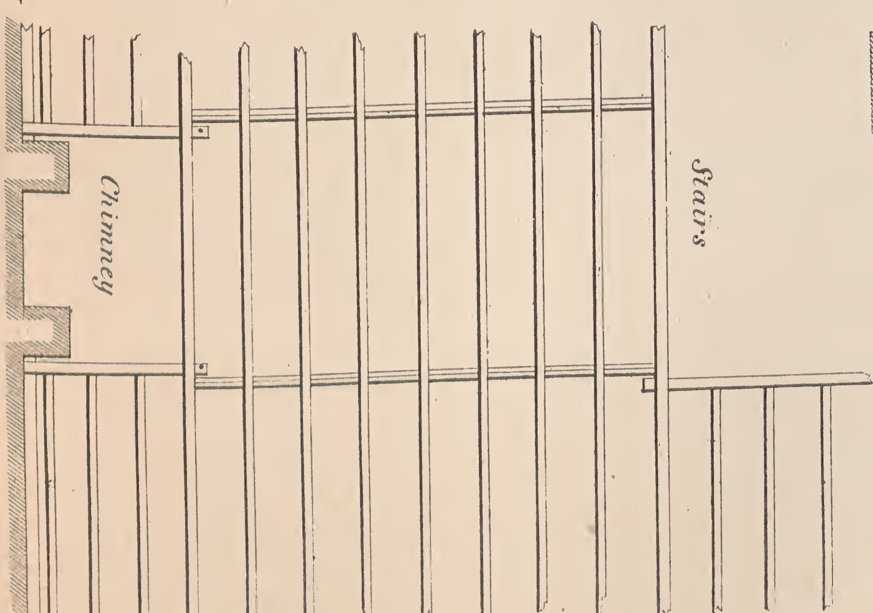


Fig. 4

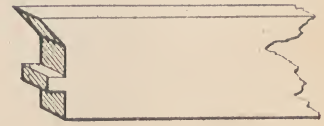
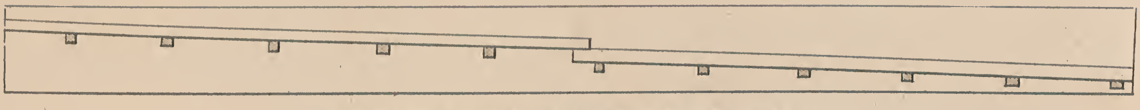


Fig. 9

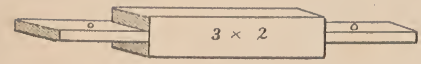
A. H. Payne

Details of Carpentry

Fig. 1.



SECTION OF GUTTER PLATE



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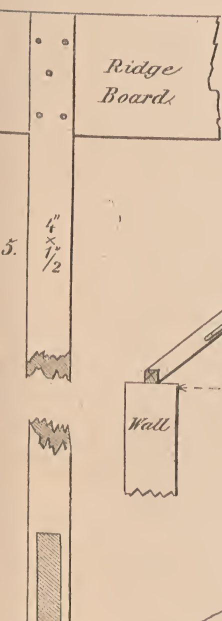

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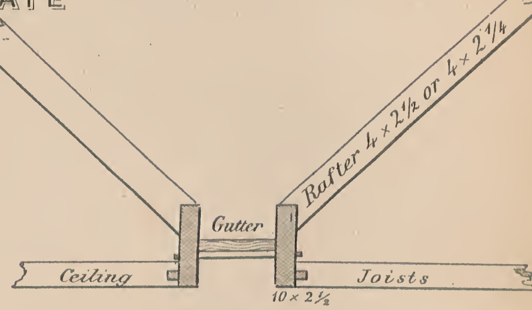


Fig. 3.

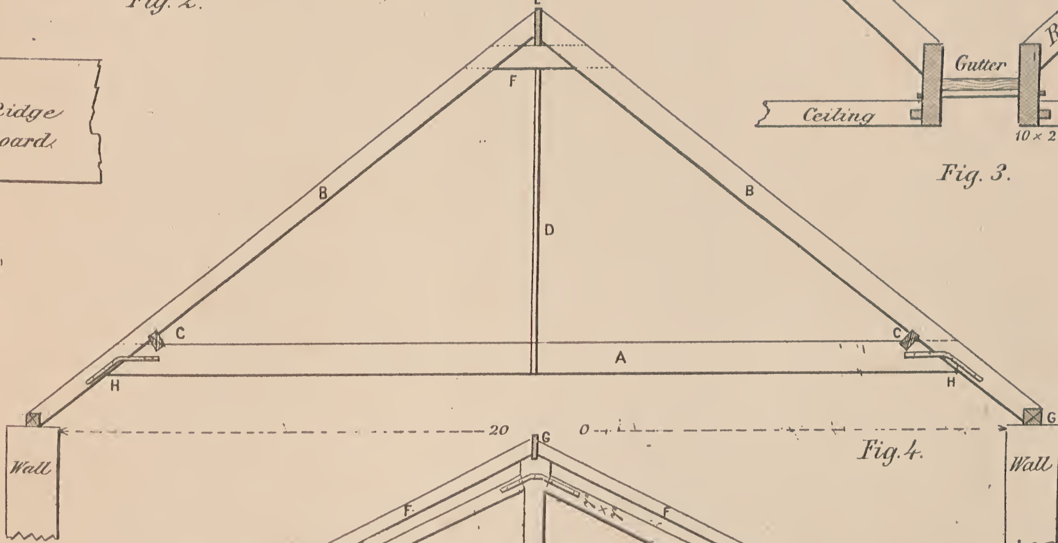


Fig. 4.

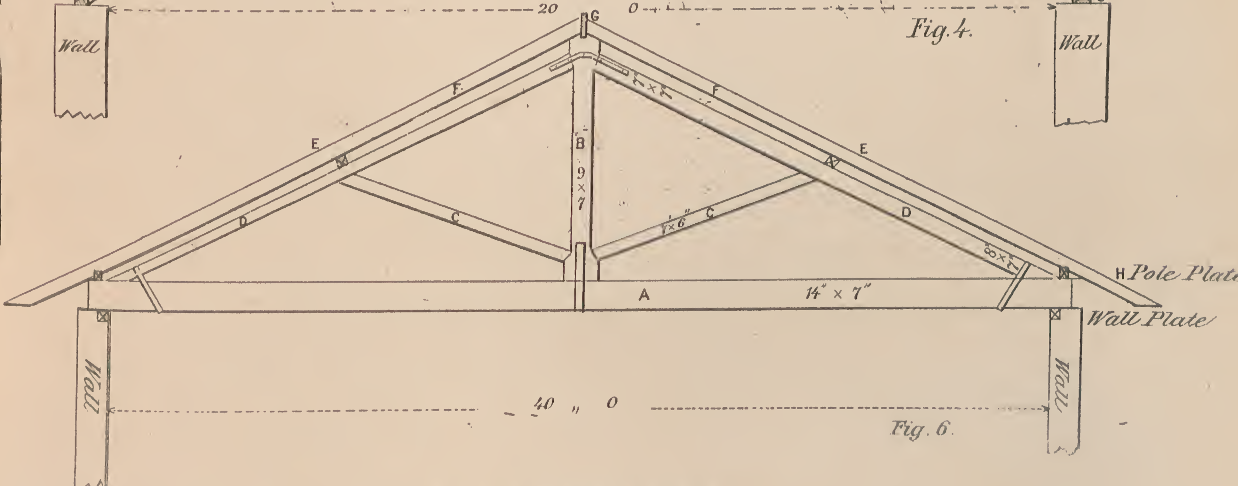


Fig. 6.

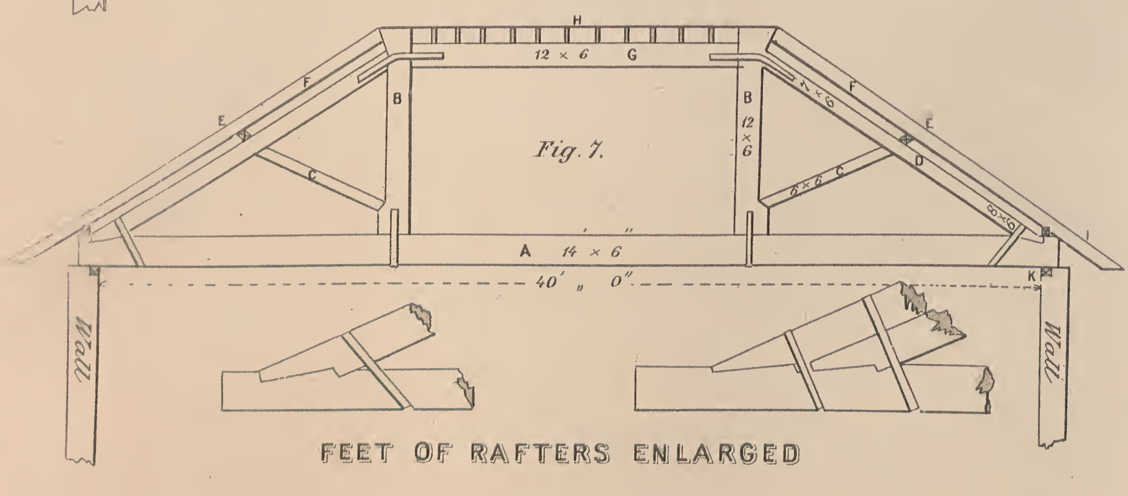
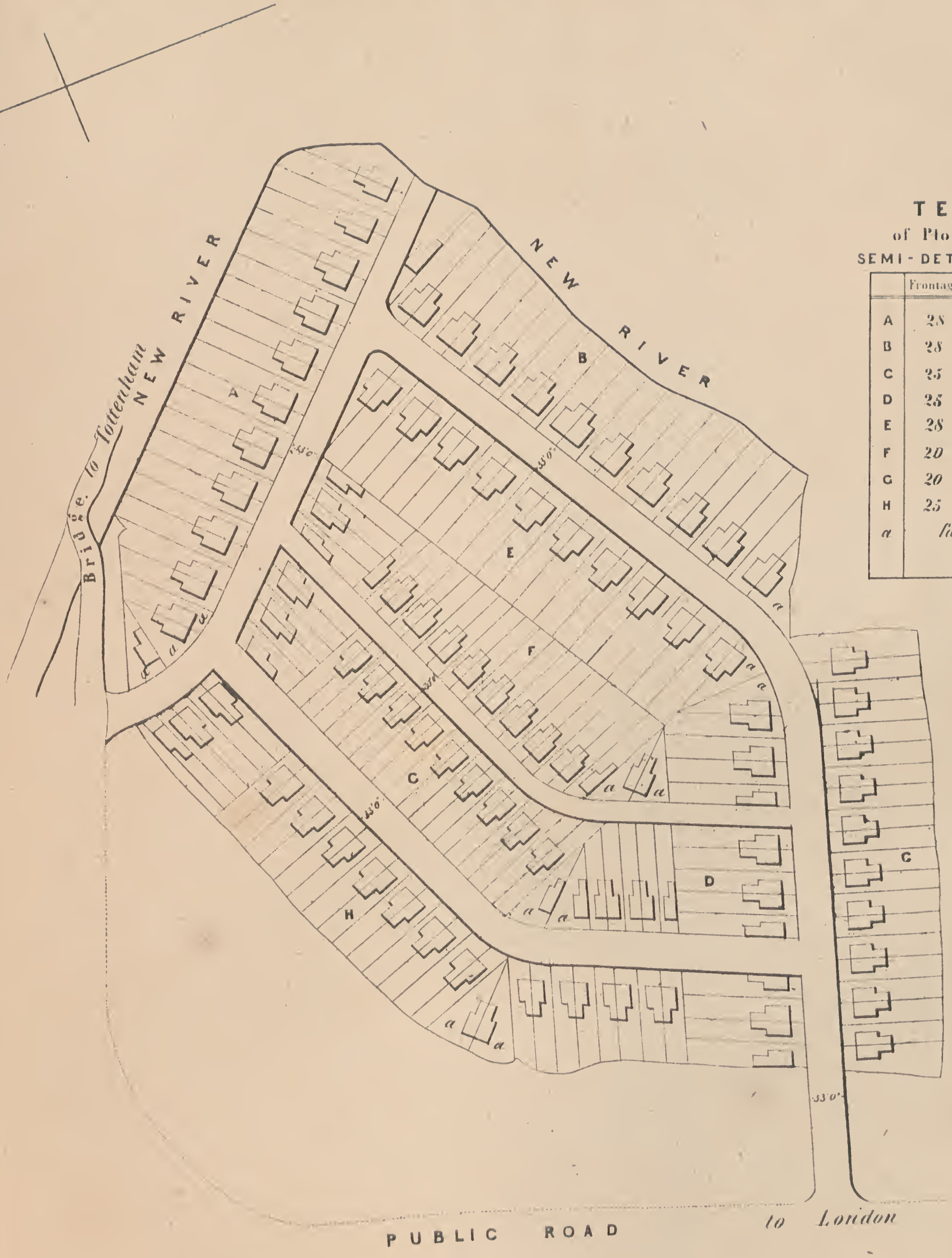


Fig. 7.

FEET OF RAFTERS ENLARGED

ALLOTMENTS OF FREEHOLD LAND

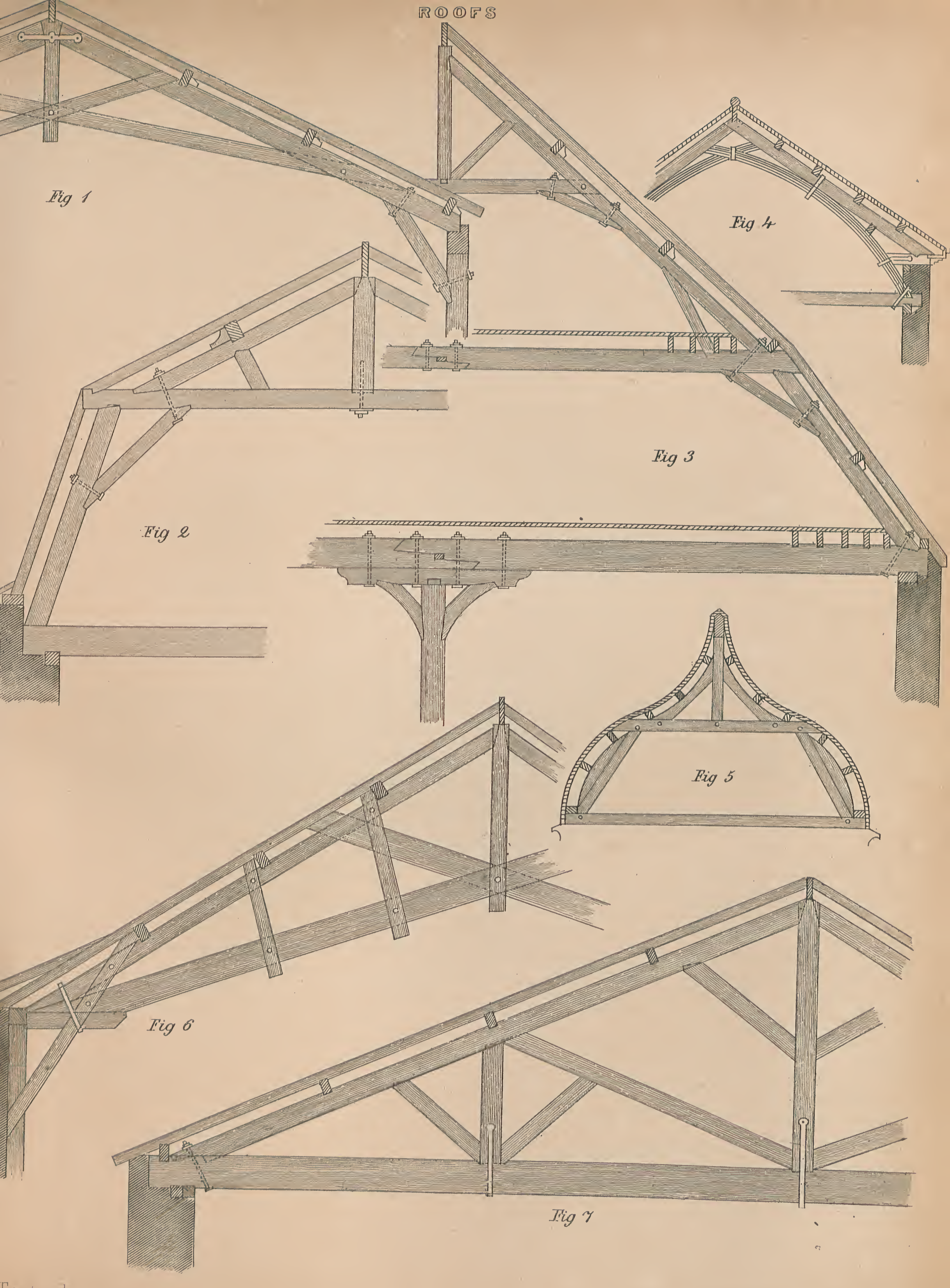


TERRIER

of Plots of Land for

SEMI-DETACHED COTTAGES

	Frontage	Depth	Nᵒ
A	28	145	20
B	28	132 average	20
C	25	120	20
D	25	132	13
E	28	132	19
F	20	120 averᵍᵉ	22
G	20	120	28
H	25	120	27
a	Various sizes		12
		Total	181



Tarbuck

ILLUSTRATIONS OF MASONRY.

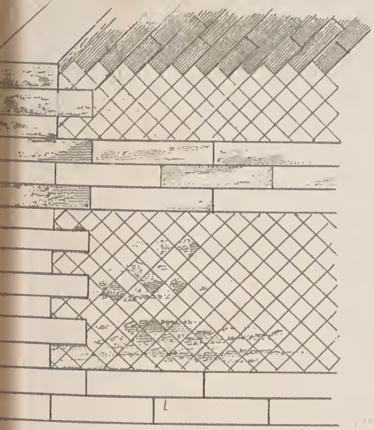


Fig. 1.

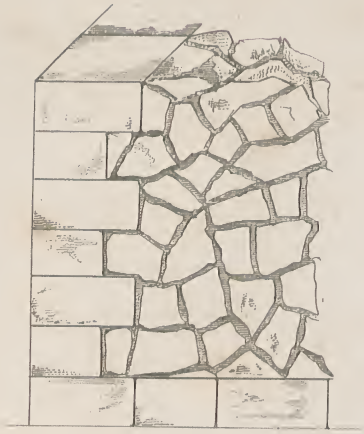


Fig. 2.

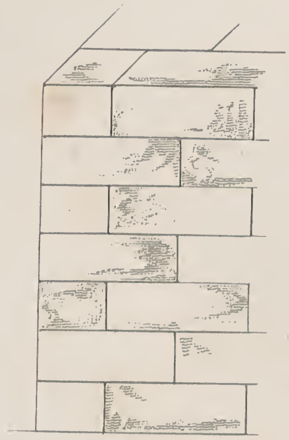


Fig. 3.

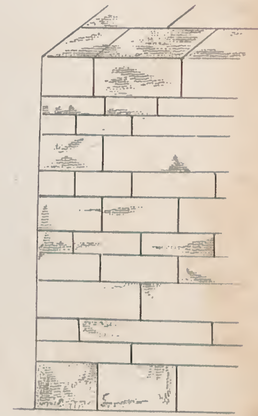


Fig. 4.

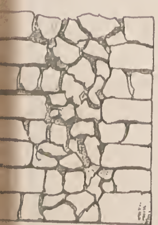


Fig. 5.

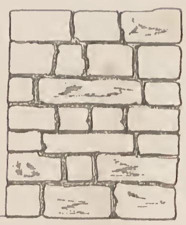
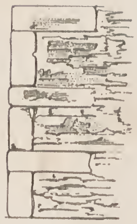


Fig. 6.



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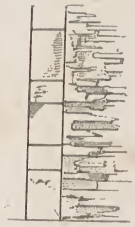


Fig. 8.

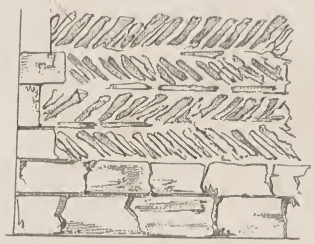


Fig. 9.

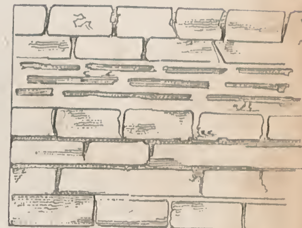
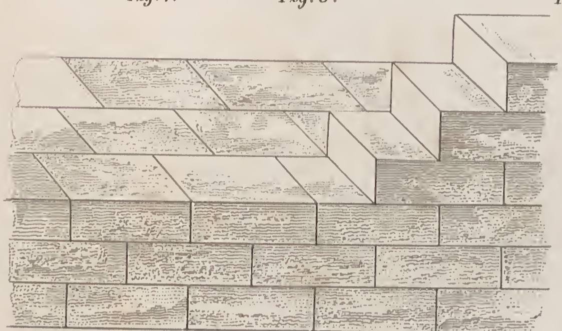


Fig. 10.

Fig. 11.



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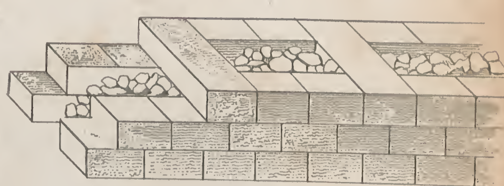


Fig. 13.

Fig. 14.

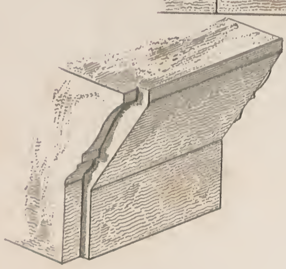
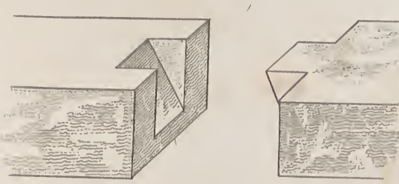


Fig. 15.



Figs. 16.

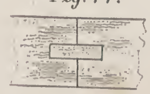


Fig. 17.

Fig. 18.

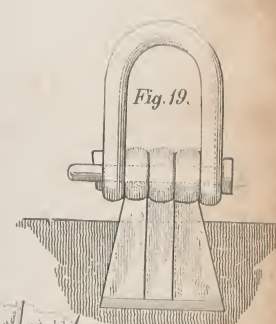


Fig. 19.

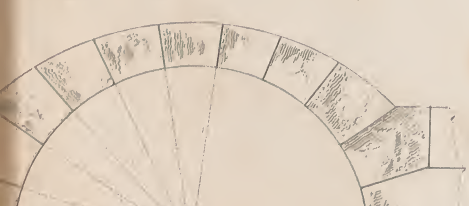


Fig. 20.

Fig. 21.

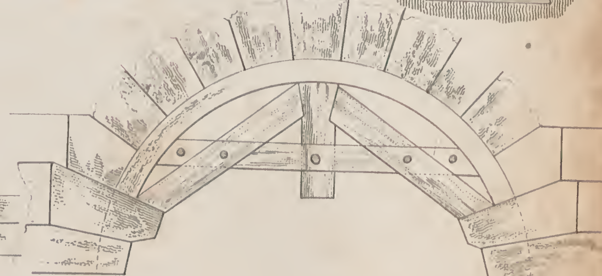


Fig. 22.

E. L. Tarbuck

A. H. Payne sc

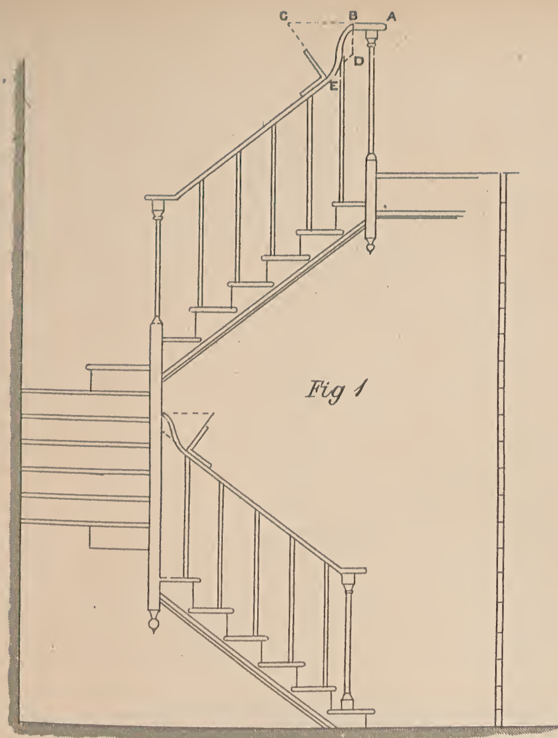


Fig 1

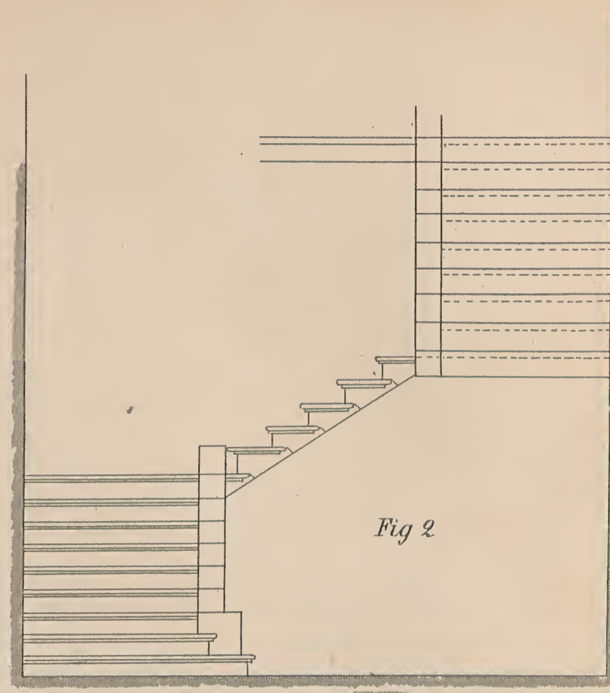


Fig 2

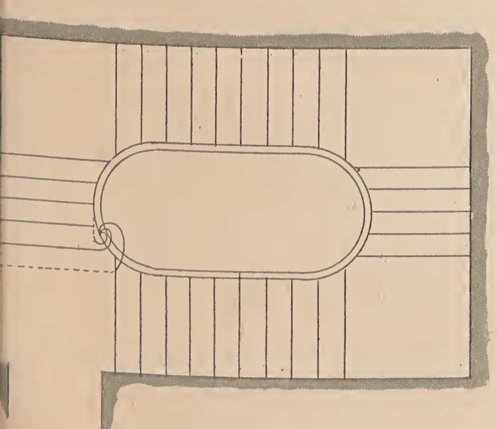


Fig 3

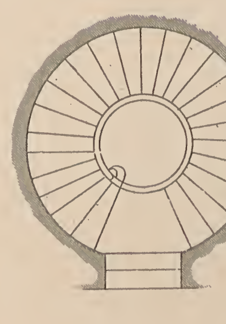


Fig 4

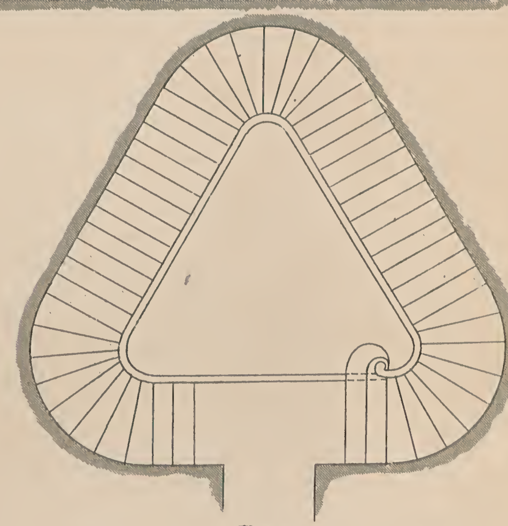


Fig 5

Fig 6

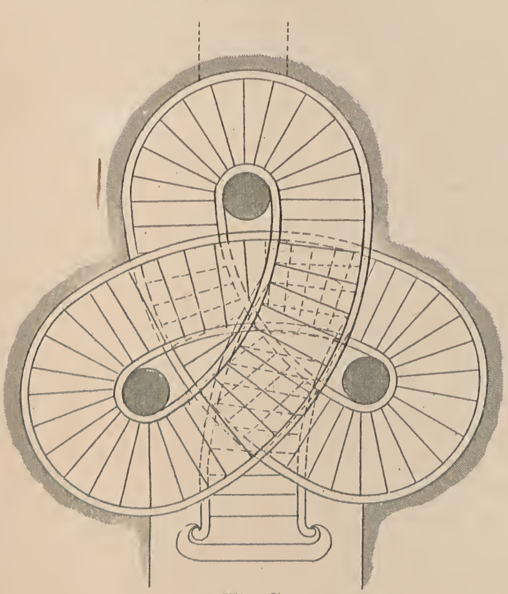


Fig 7

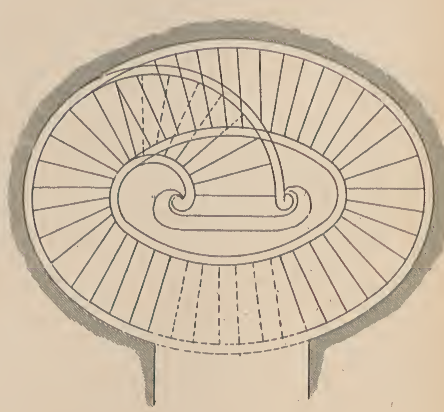


Fig 8

E. L. Tarbuck

A. H. Payne sc

LABOURERS COTTAGE.

adapted for a narrow slip of land

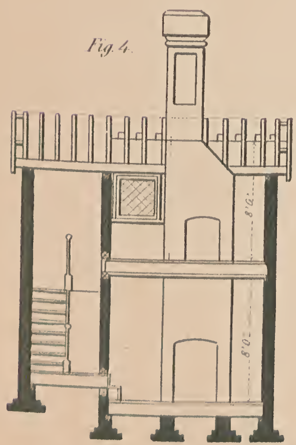
Fig. 1.

ELEVATION

Fig. 3 *Fig. 2*

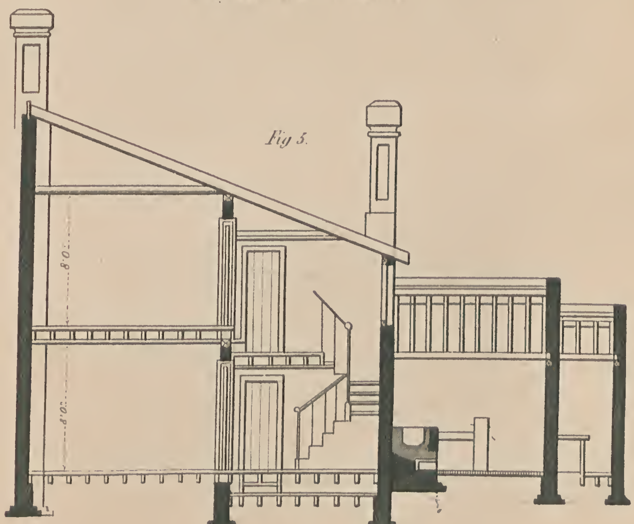
BED-ROOM-FLOOR GROUND-PLAN

Fig. 4.



SECTION AT A.B.

Fig. 5.



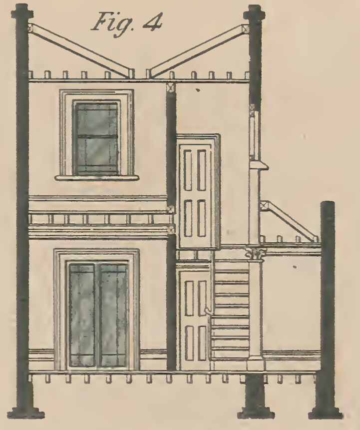
SECTION AT C.D.

SCALE OF 10 9 8 7 6 5 4 3 2 1 0 10 20 30 FEET

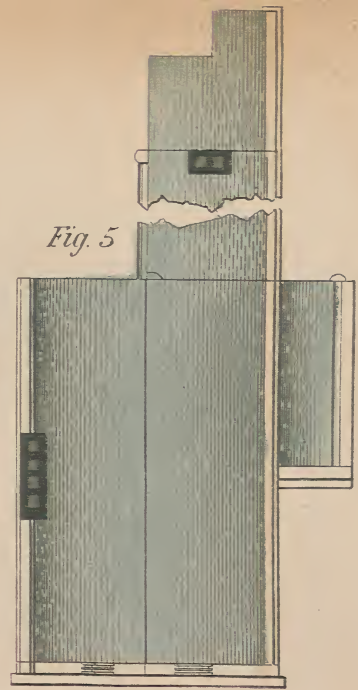
A. H. Sayer sc.

PLAN FOR TWO FOURTH RATE HOUSES.

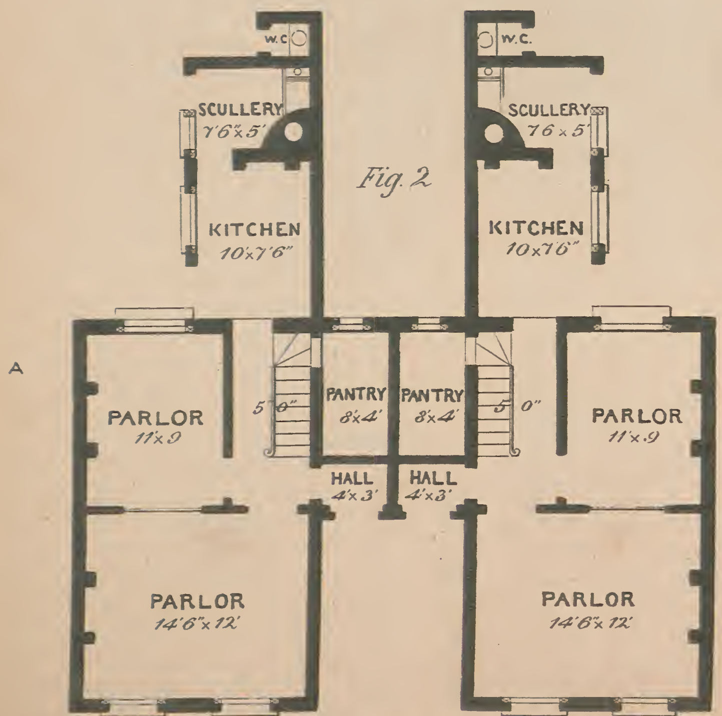
ELEVATION



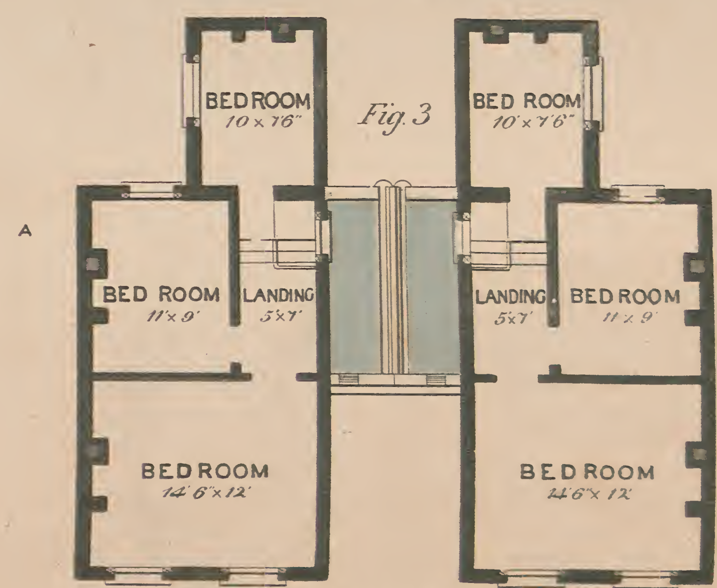
SECTION AT A.B.



PLAN OF ROOF



GROUND PLAN

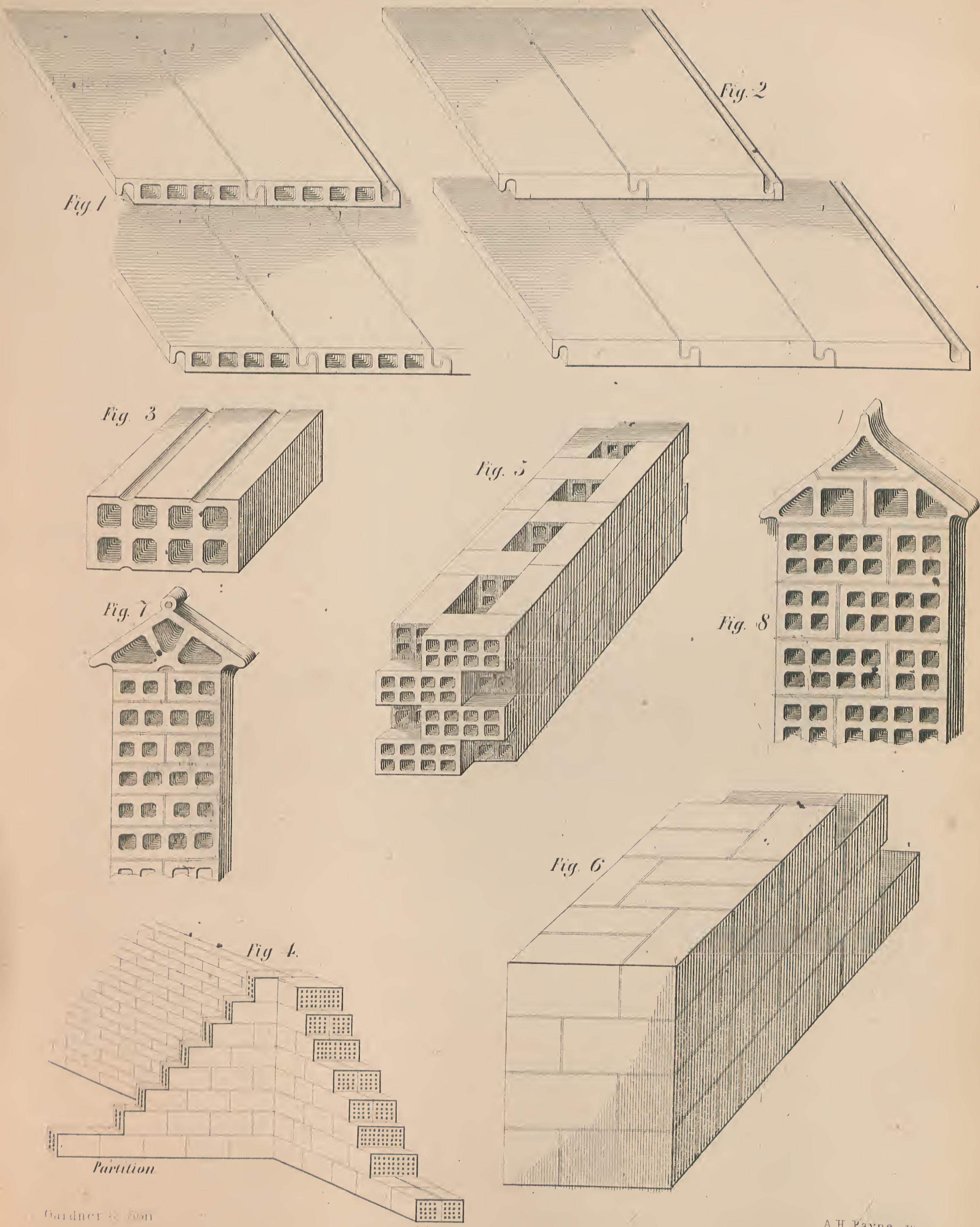


FIRST FLOOR PLAN

PLAN OF LAND
FOR
FREEHOLD ALLOTMENTS

FREEHOLD ALLOTMENTS

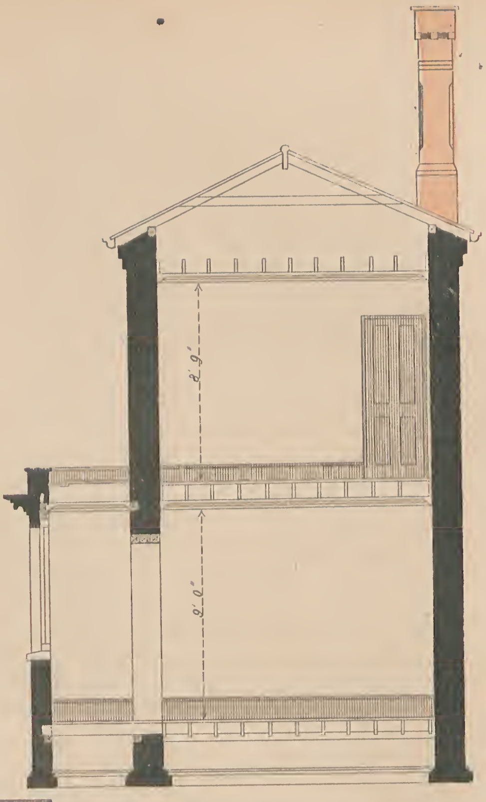
SECTION of ROADS



Gardner & Son

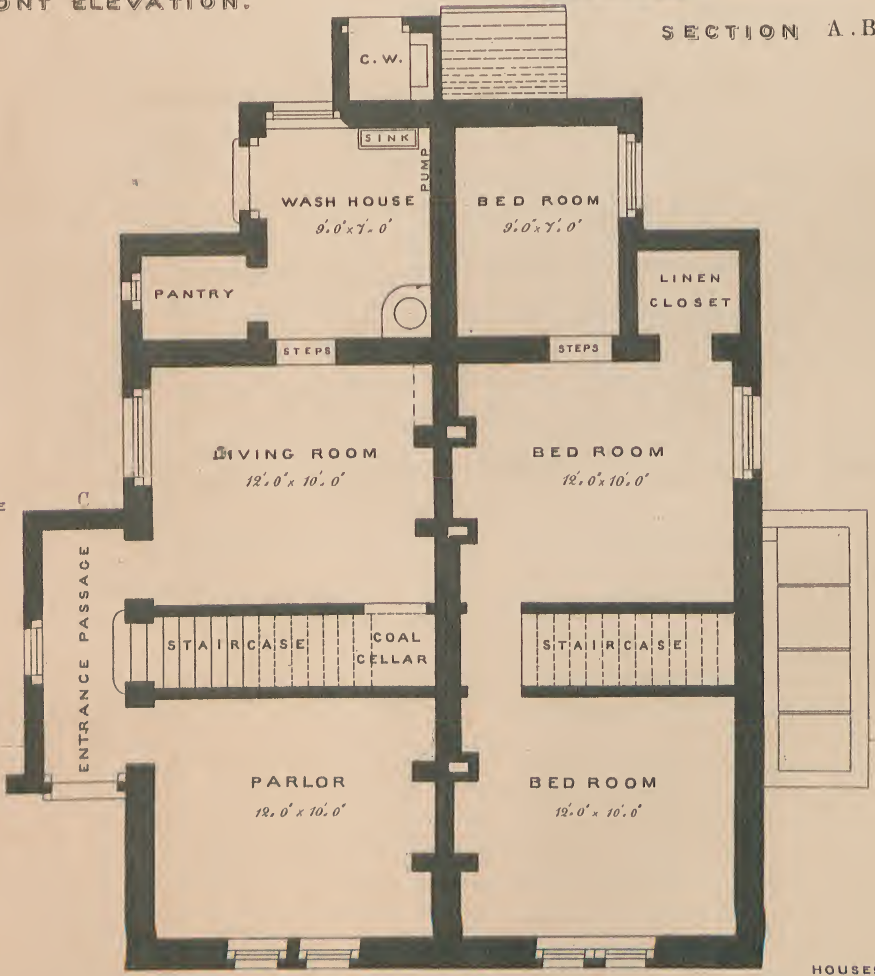
A.H. Payne sc.

FRONT ELEVATION.



SECTION A.B.

DOOR AT C IF DESIRABLE

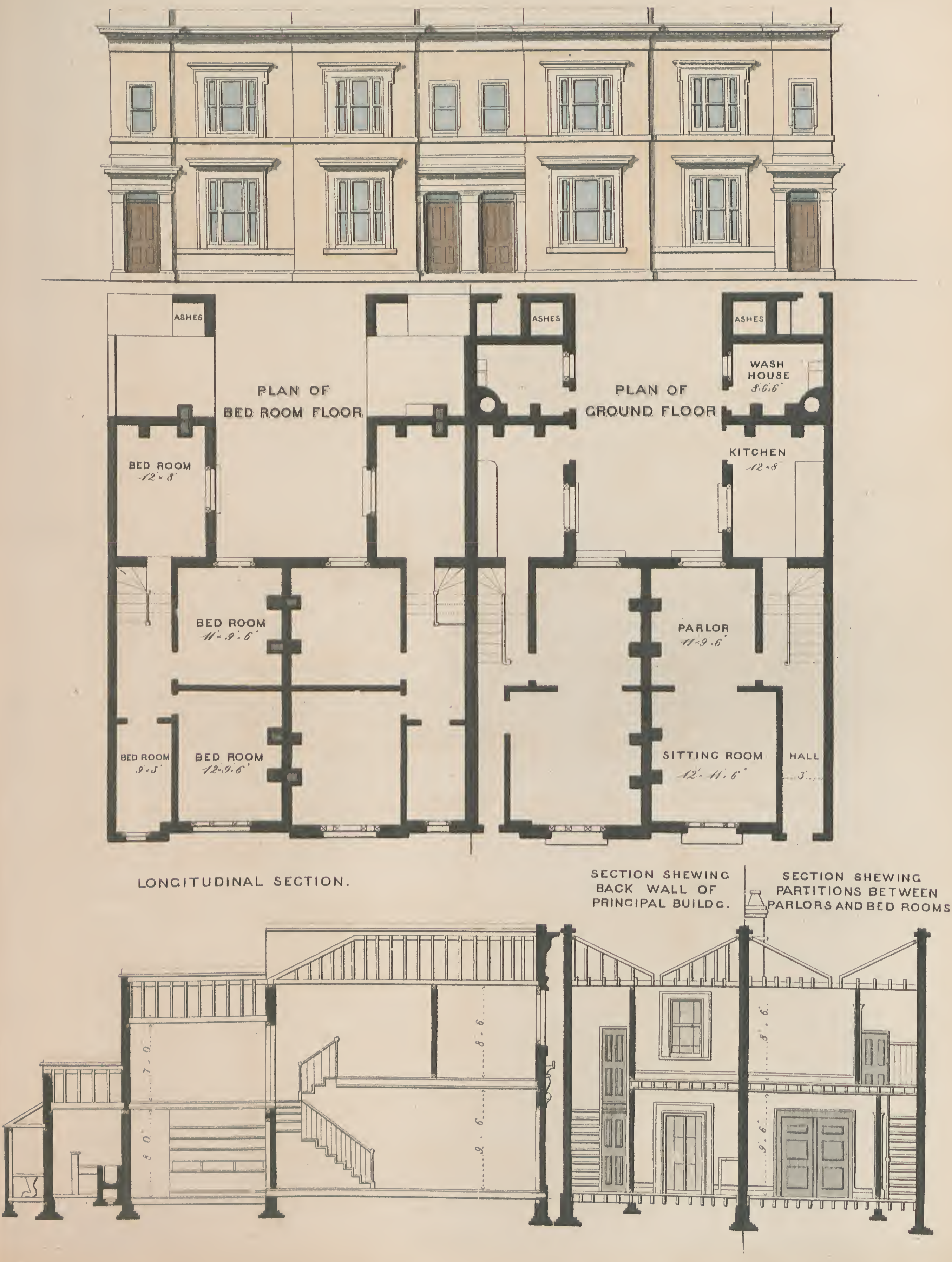


HOUSES ON THIS PLAN MAY BE CONVENIENTLY ERECTED IN PAIRS

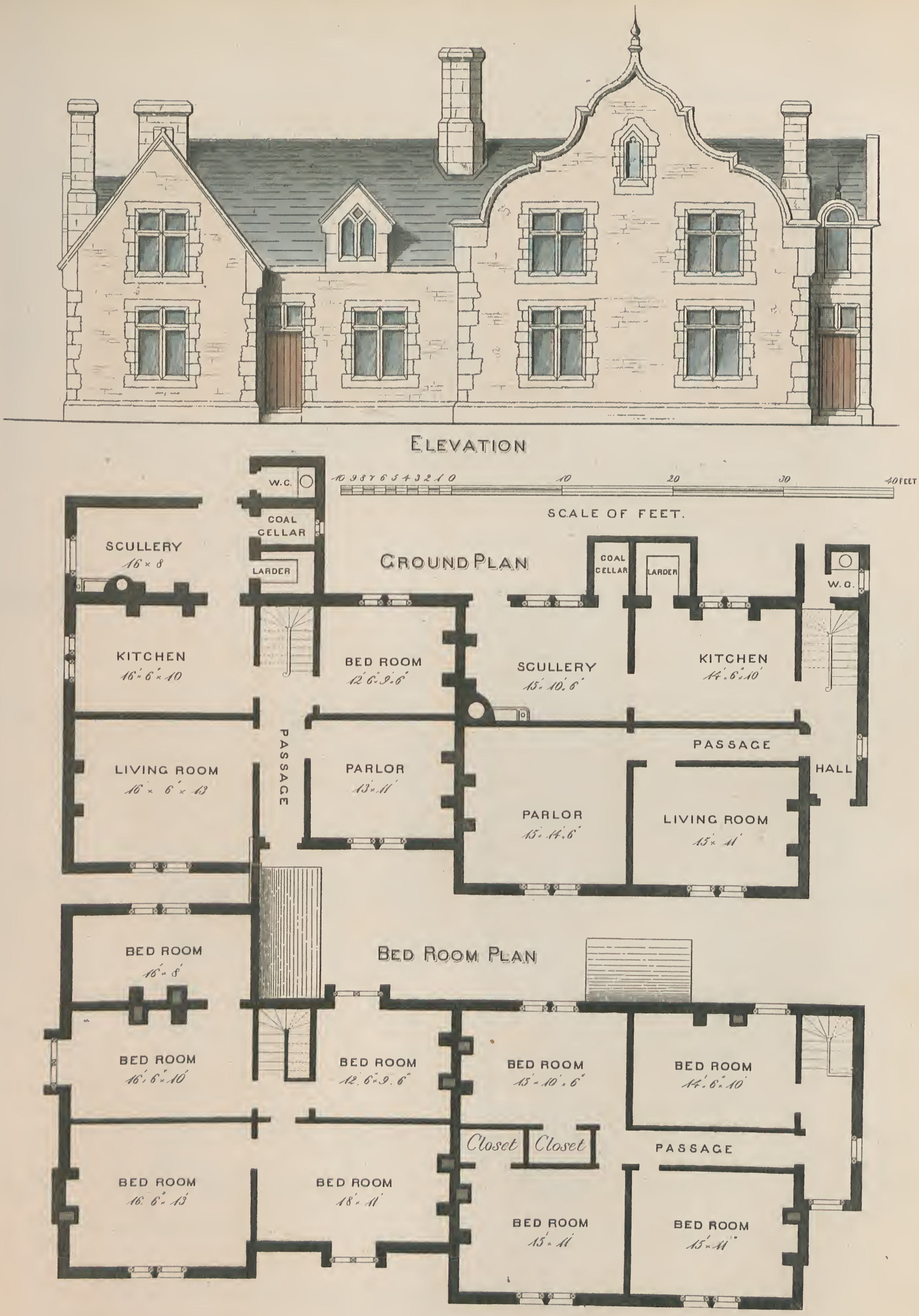
GROUND PLAN. CHAMBER PLAN.

10 5 0 10

ELEVATION FOR FOUR FOURTH-RATE HOUSES AND ADDITIONS.

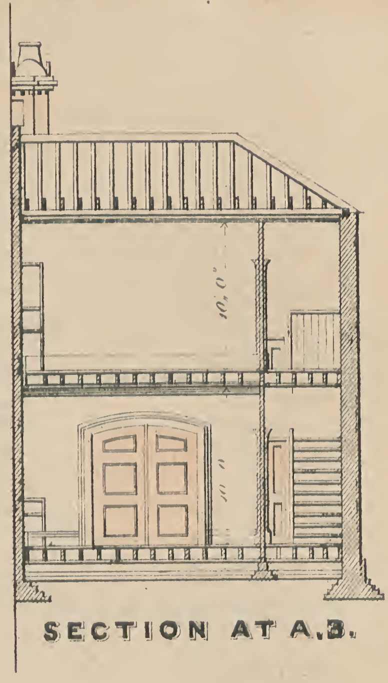


SEMI-DETACHED FAMILY COTTAGE RESIDENCES



PLAN AND ELEVATION OF TWO 3RD RATE SEMI-DETACHED SEVEN ROOMED COTTAGES ADAPTED FOR TWO OR MORE SMALL ALLOTMENTS

ELEVATION



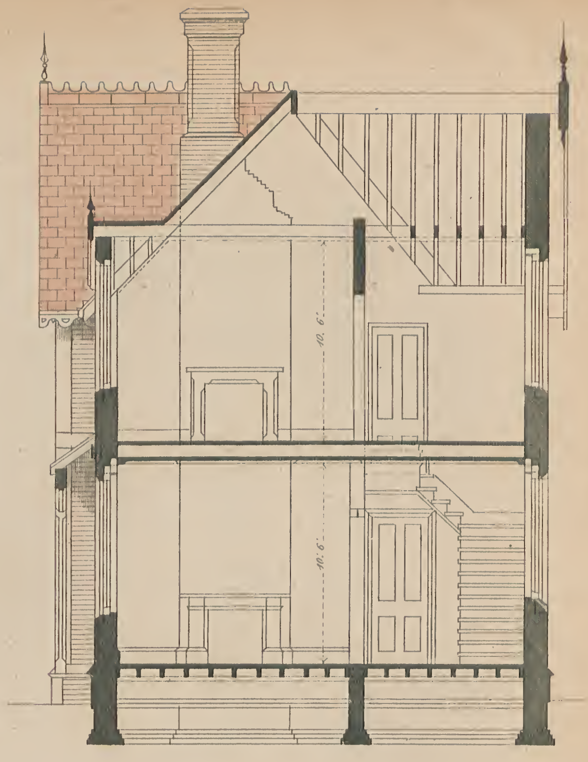
SECTION AT A.B.

GROUND PLAN

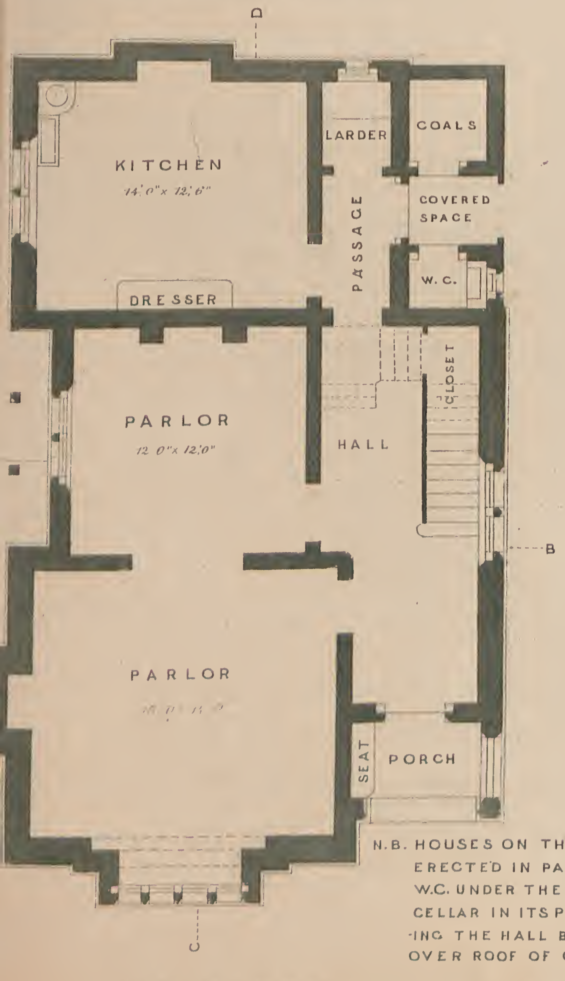
BED ROOM PLAN

SCALE OF FEET

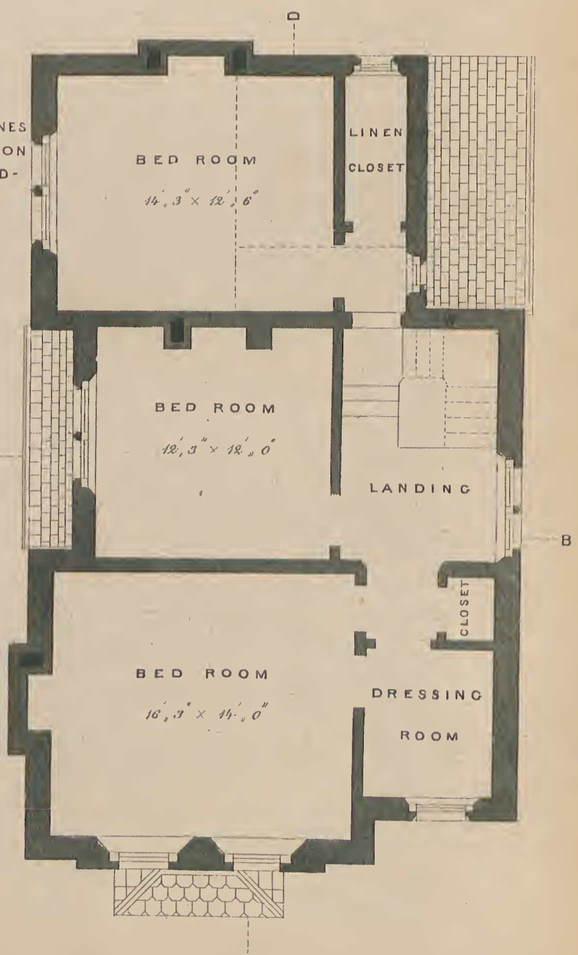
FRONT-ELEVATION.



SECTION A. B.



THE DOTTED LINES INDICATE DIVISION INTO TWO BED-ROOMS.

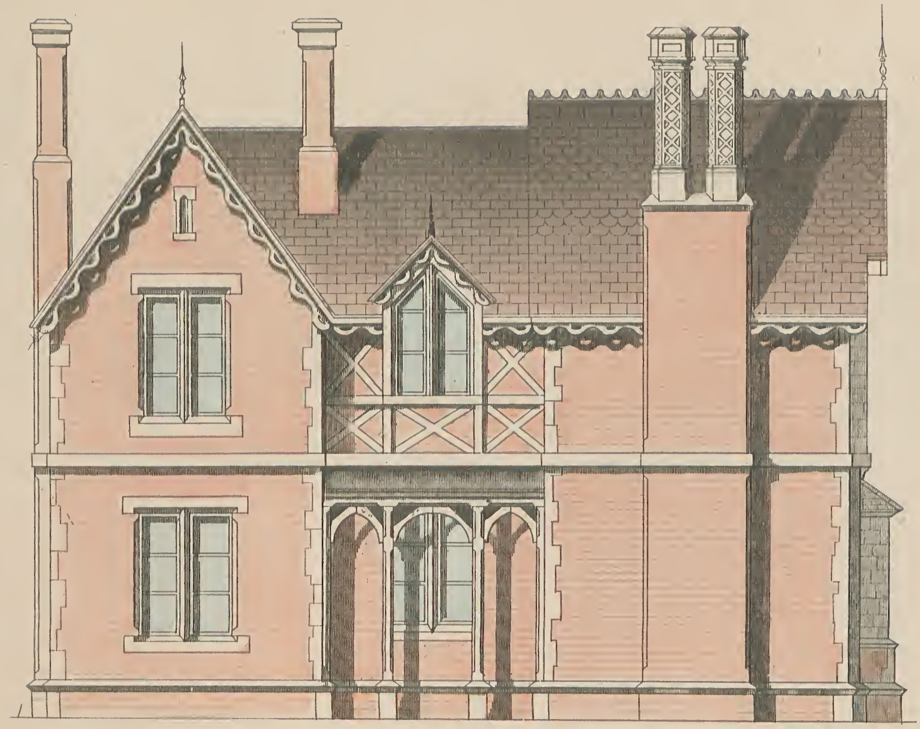


N.B. HOUSES ON THIS PLAN MAY BE ERECTED IN PAIRS, PLACING THE W.C. UNDER THE STAIRS THE COAL CELLAR IN ITS PLACE AND LIGHTING THE HALL BY WINDOW AT W. OVER ROOF OF COAL CELLAR.

GROUND-PLAN.

CHAMBER PLAN

SCALE OF 10 5 0 10 FEET.



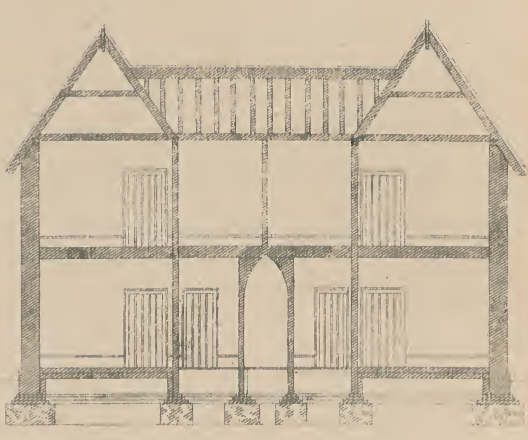
Side-Elevation.

Section C.D

Scale of 10 5 0 10 20 Feet.

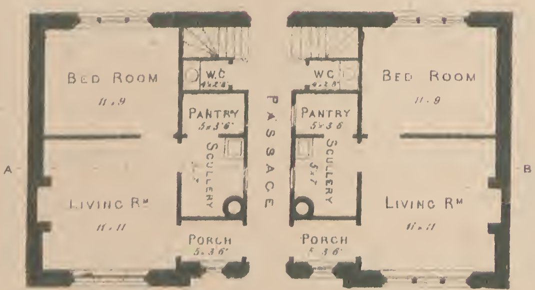
WORKMENS COTTAGES

ELEVATION

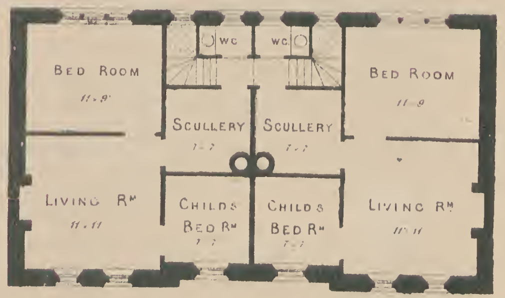


TRANSVERSE SECTION
ON LINE AB

ELEVATION FOR A ROW



GROUND FLAT



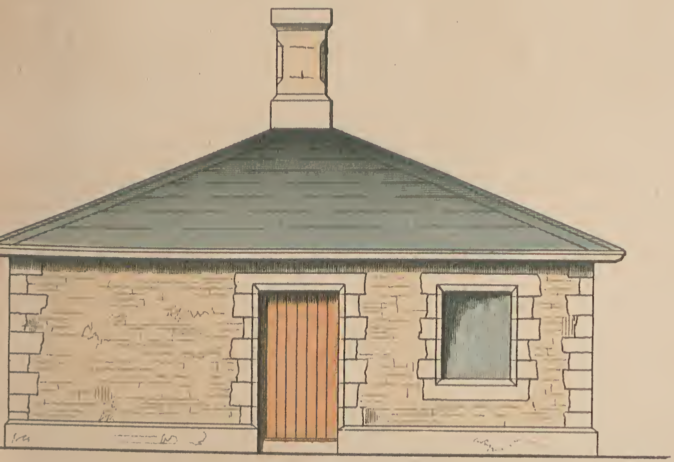
UPPER FLAT

SCALE OF FEET

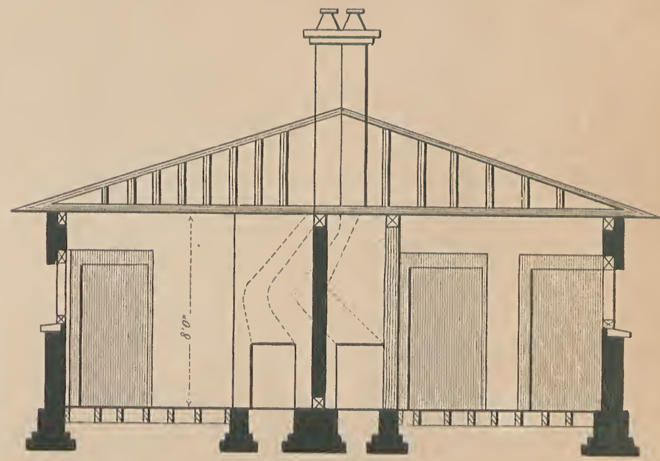
Labourer's Cottage.

Elevation.

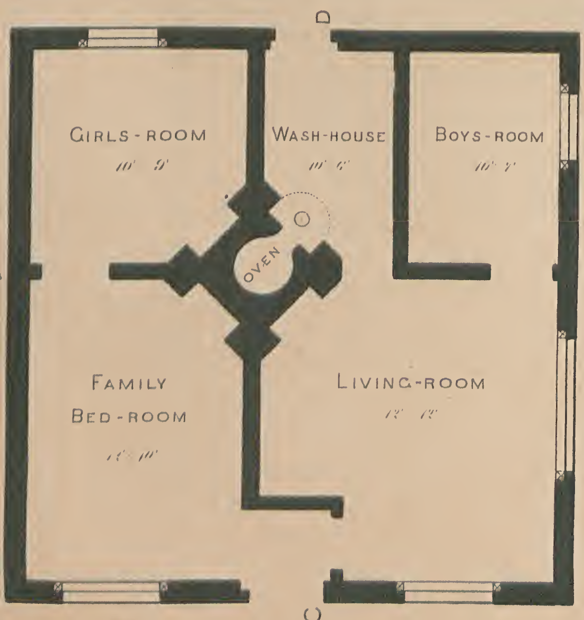
Side Elevation Right Hand.



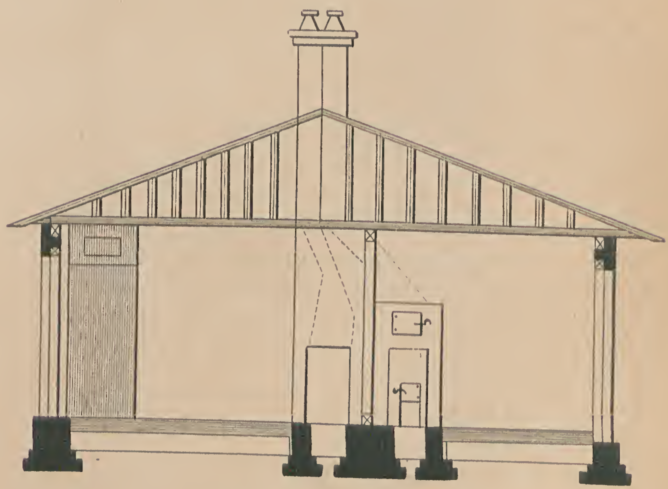
Back Elevation.



Section at A. B.



Plan.



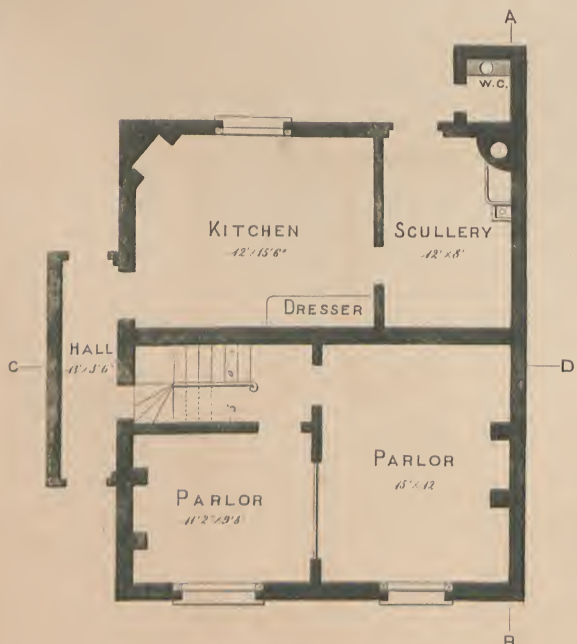
Section at C. D.

PLAN OF A FOURTH RATE HOUSE ADDITIONS.

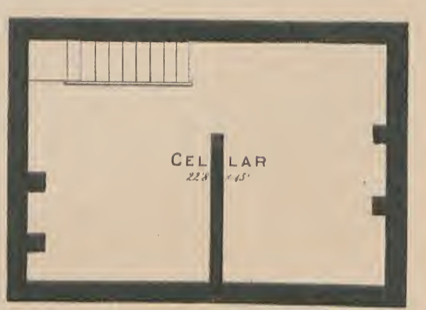
ELEVATION.

FIRST FLOOR PLAN.

SCALE OF FEET.



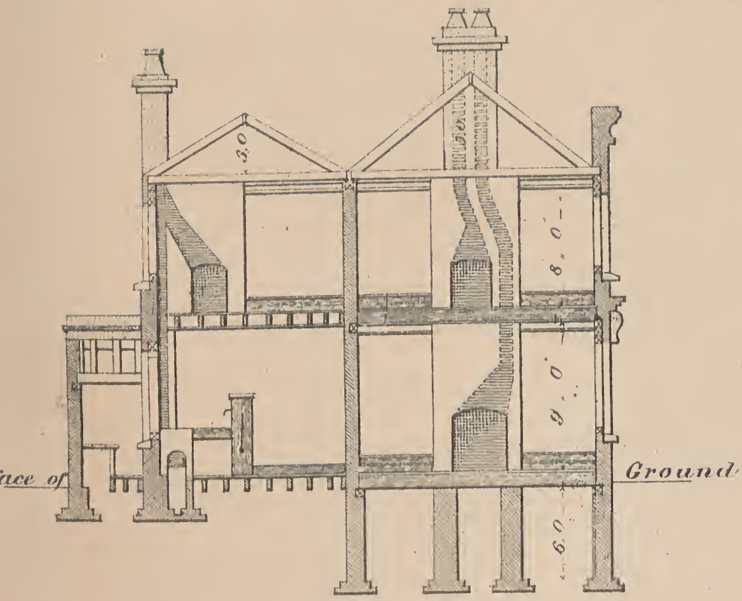
GROUND PLAN.



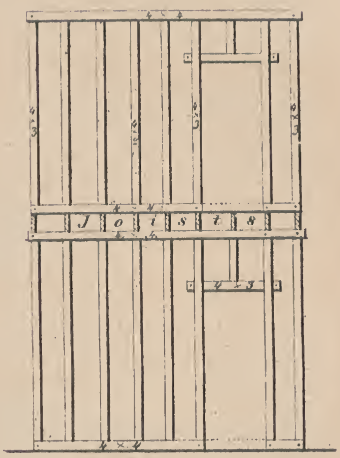
CELLAR PLAN.

A. H. Payne sc.

SECTIONS AND PARTITIONS FOURTH RATE HOUSE AND ADDITIONS

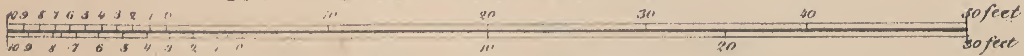


SECTION AT A.B.

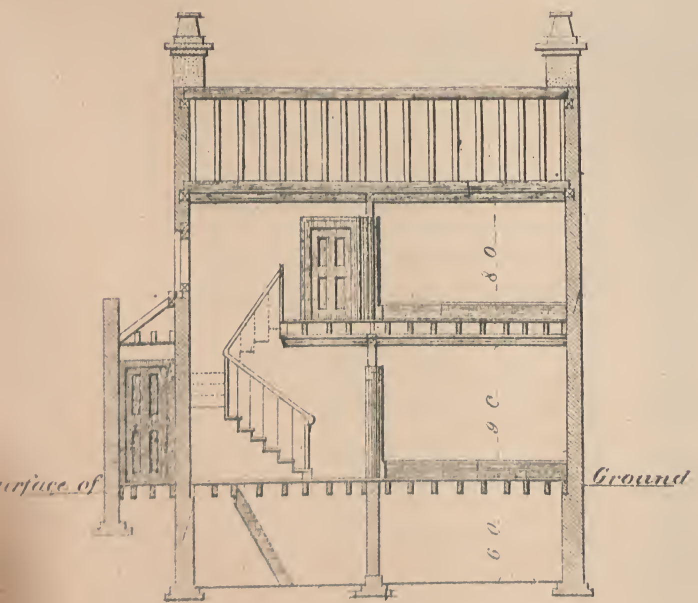


Naked Partitions between Parlor and Bedroom and Staircase

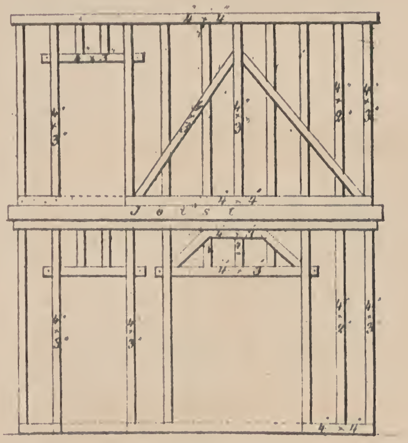
SCALE of Feet for Sections



SCALE of Feet for Partitions



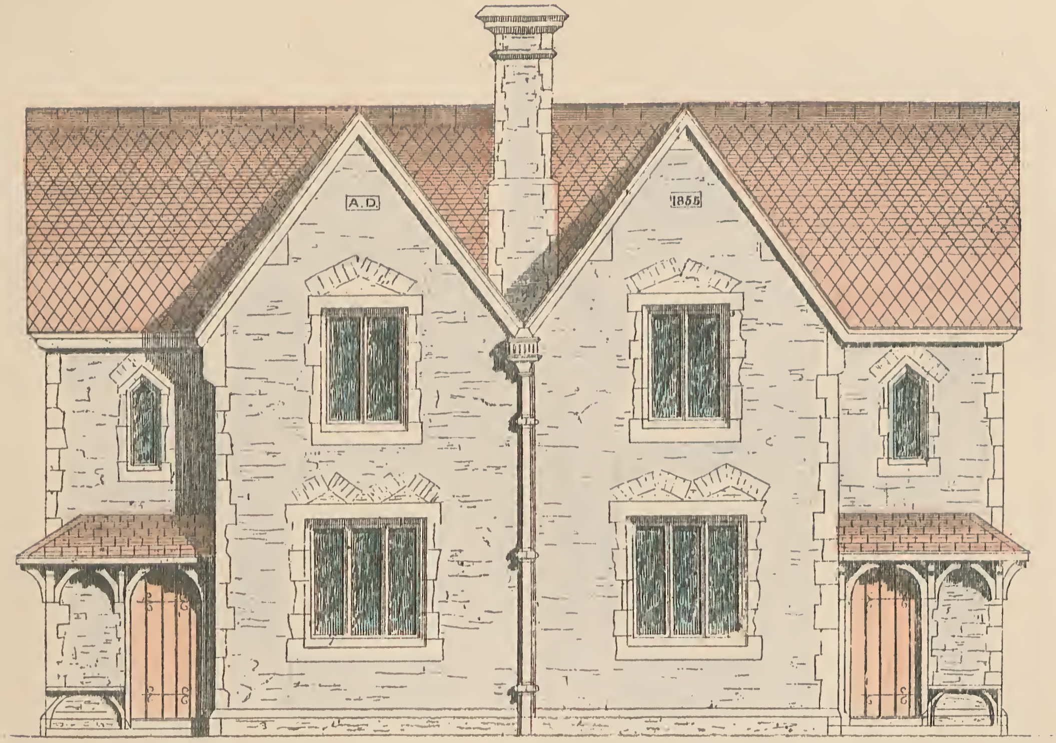
SECTION AT C.D.



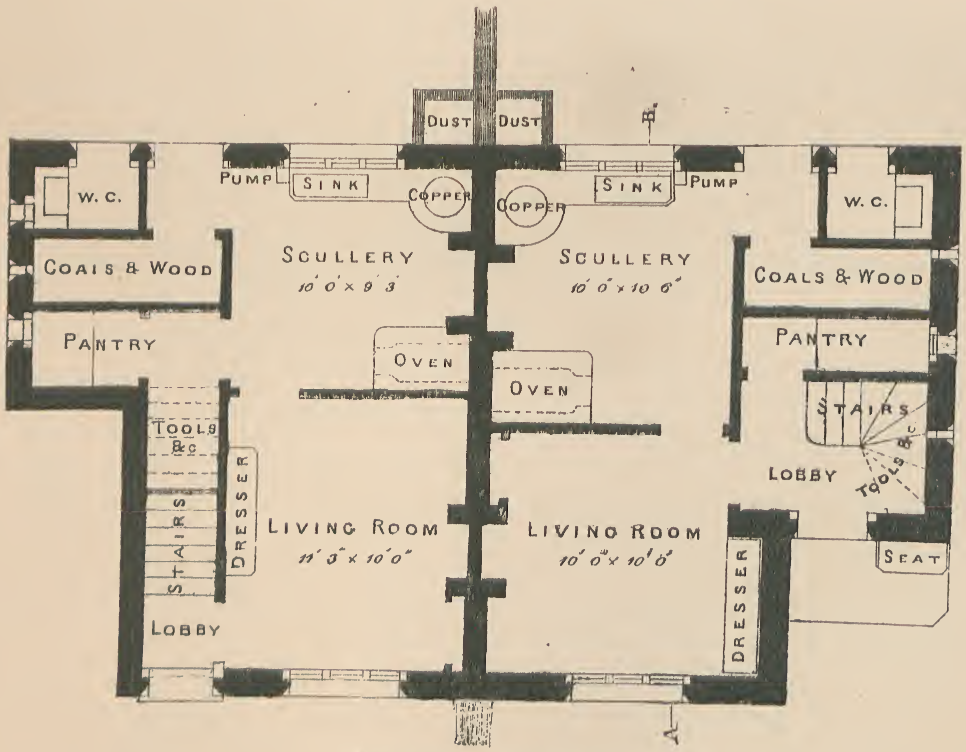
Naked Partition between Parlors and Bedrooms

DESIGNS FOR A PAIR OF MODEL COTTAGES,

FOR LABOURERS, MECHANICS, &C.



FRONT ELEVATION



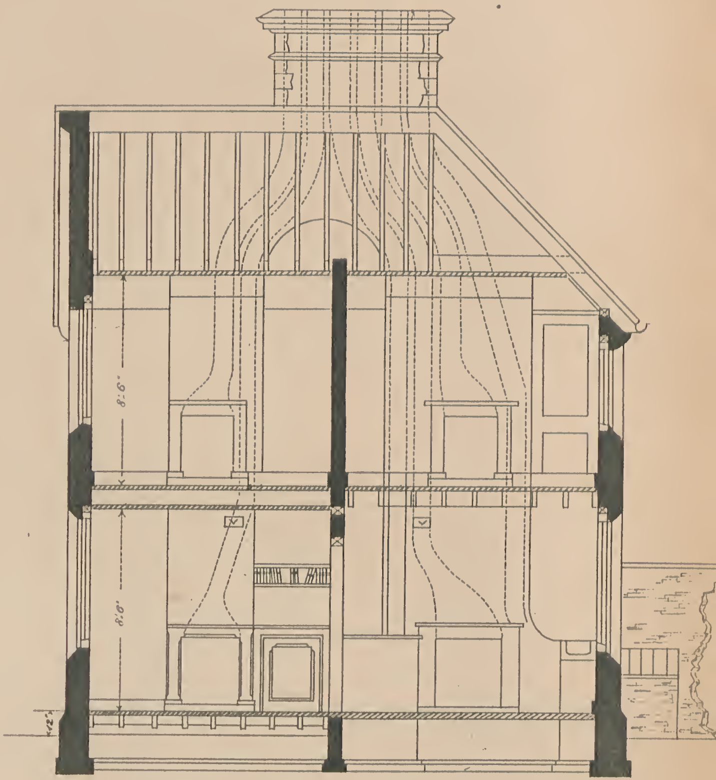
GROUND PLAN

SCALE OF FEET

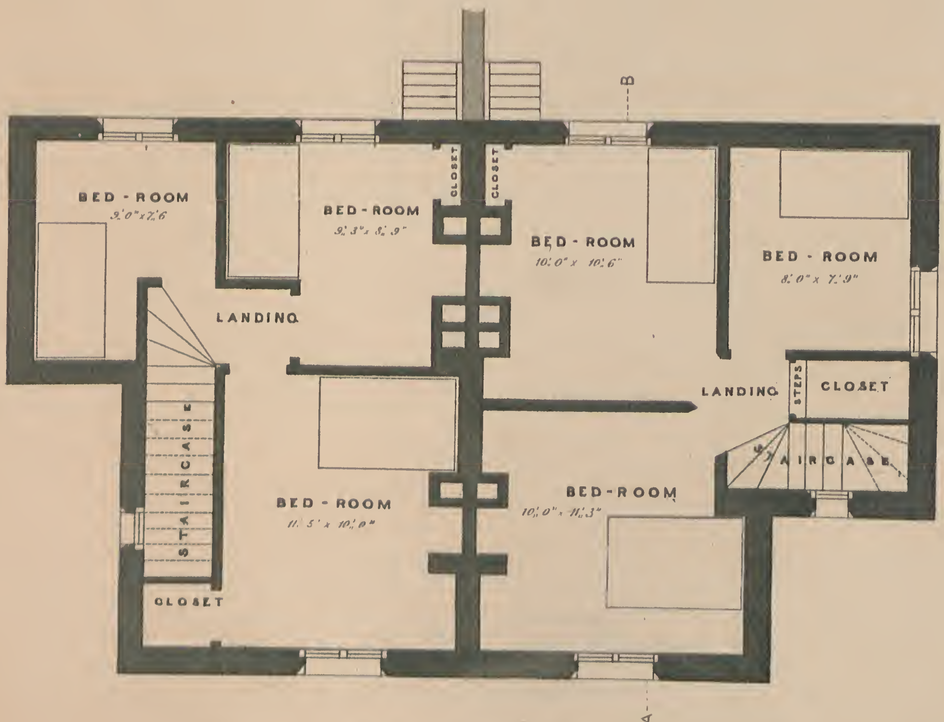
Designs for a pair of Model Cottages.

FOR LABOURERS, MECHANICS, &C.

Side - Elevation.



Section A.B.

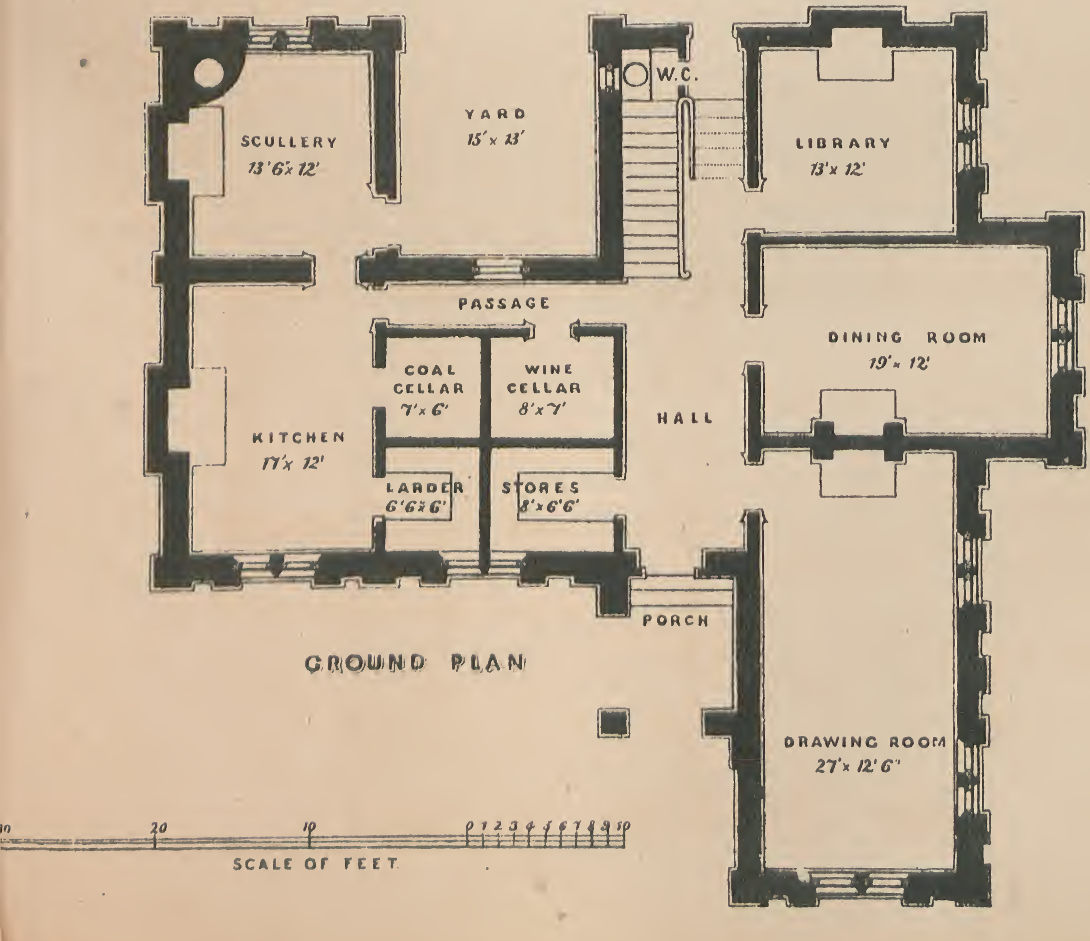


Chamber-Plan.

SCALE OF 10 5 10 FEET

A. H. Payne sc.

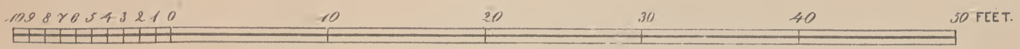
ELEVATION FOR A GENTLEMAN'S VILLA



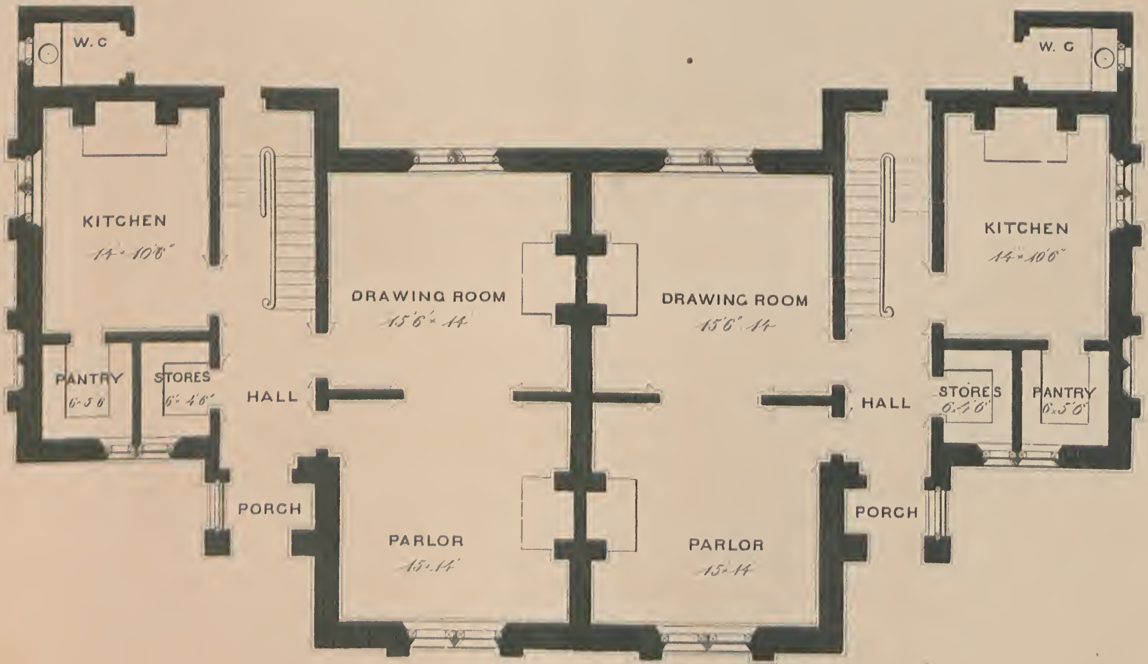
GROUND PLAN

PAIR OF SEMI DETACHED SEVEN ROOMED HOUSES AND OFFICES

ELEVATION



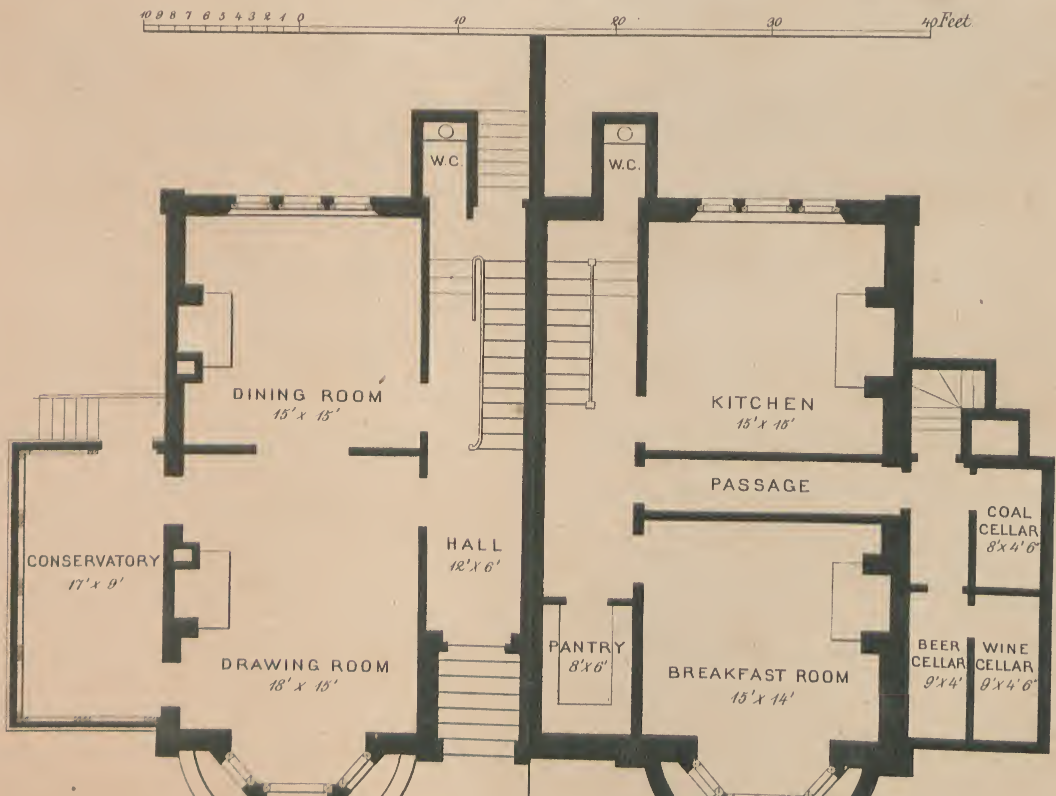
SCALE OF FEET



GROUND PLAN

PLANS AND ELEVATION OF TWO SEMI-DETACHED NINE ROOMED HOUSES WITH CONSERVATORY AND OFFICES.

ELEVATION.



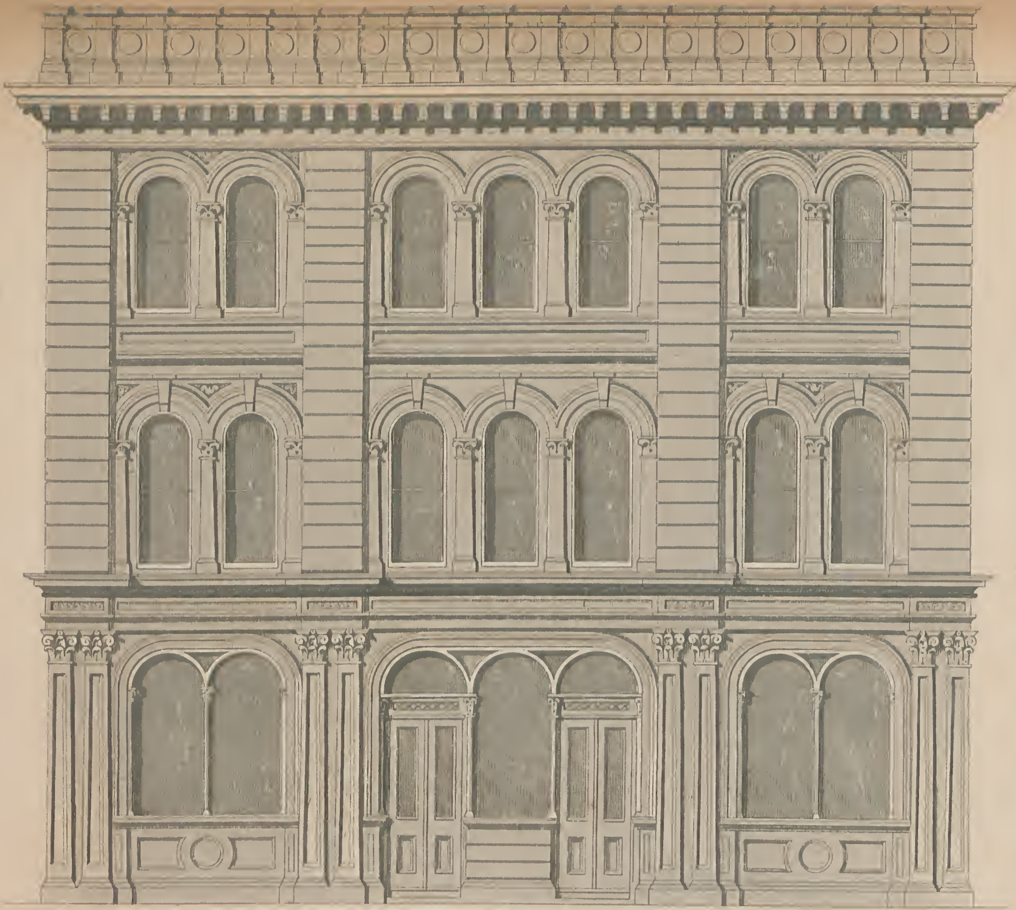
GROUND PLAN

BASEMENT PLAN

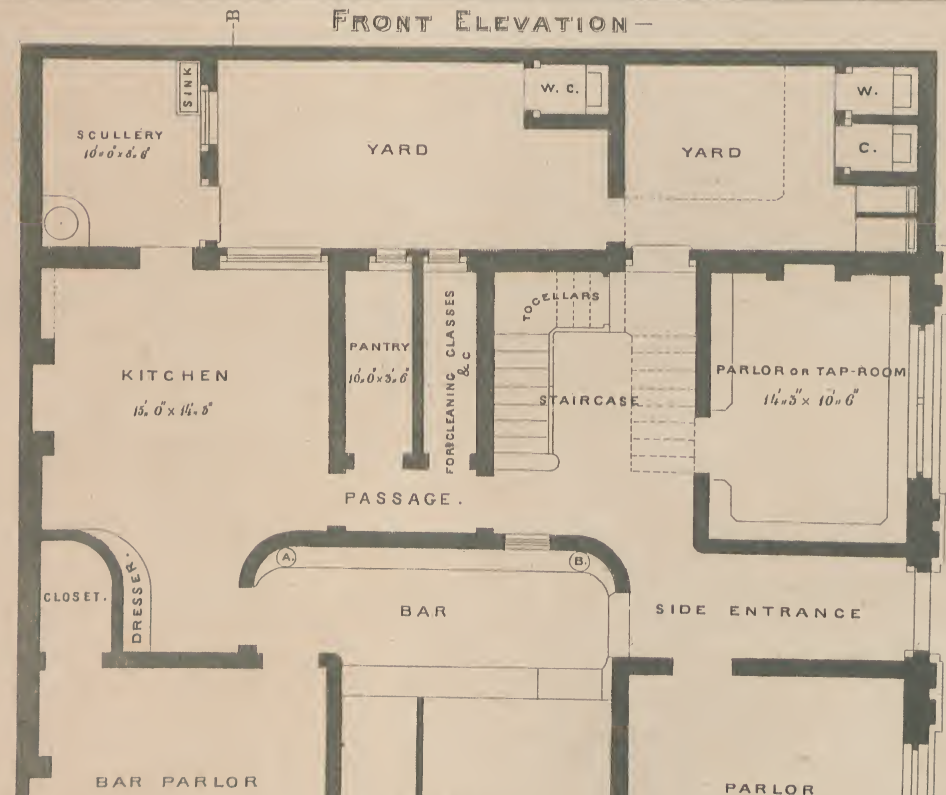
ner & Son

A H Payne sc

Design for a First Class Tavern.



Front Elevation—



A. FILTER

B. STOVE WITH HOT WATER

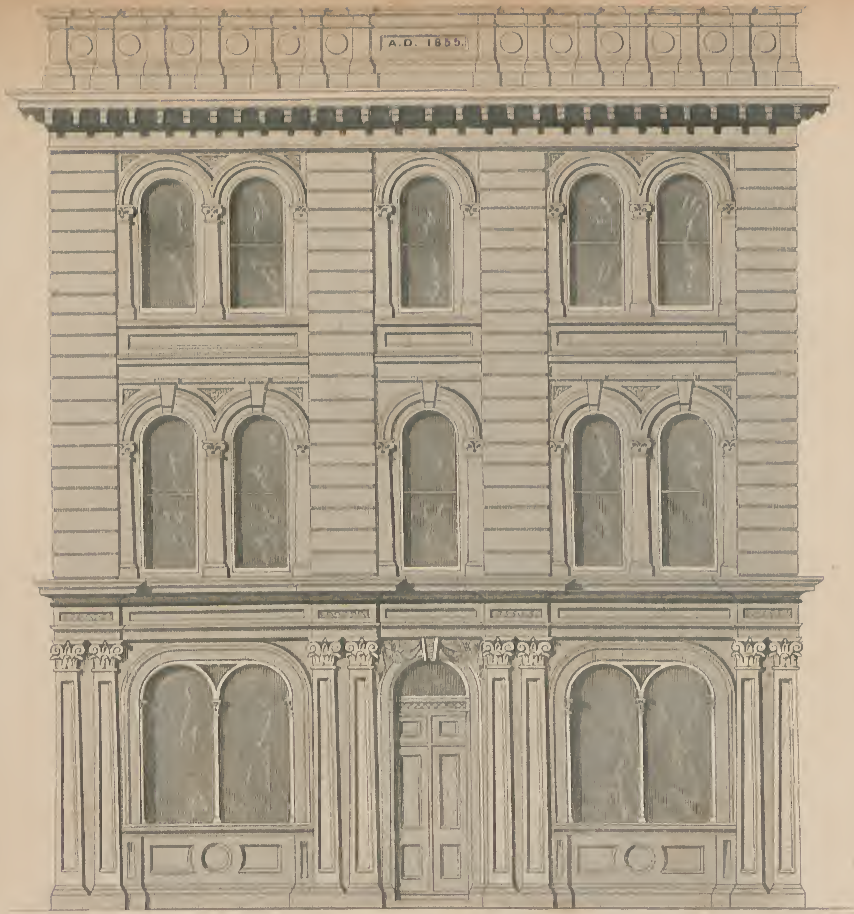
Plan of Ground Floor

…arbuck inv.

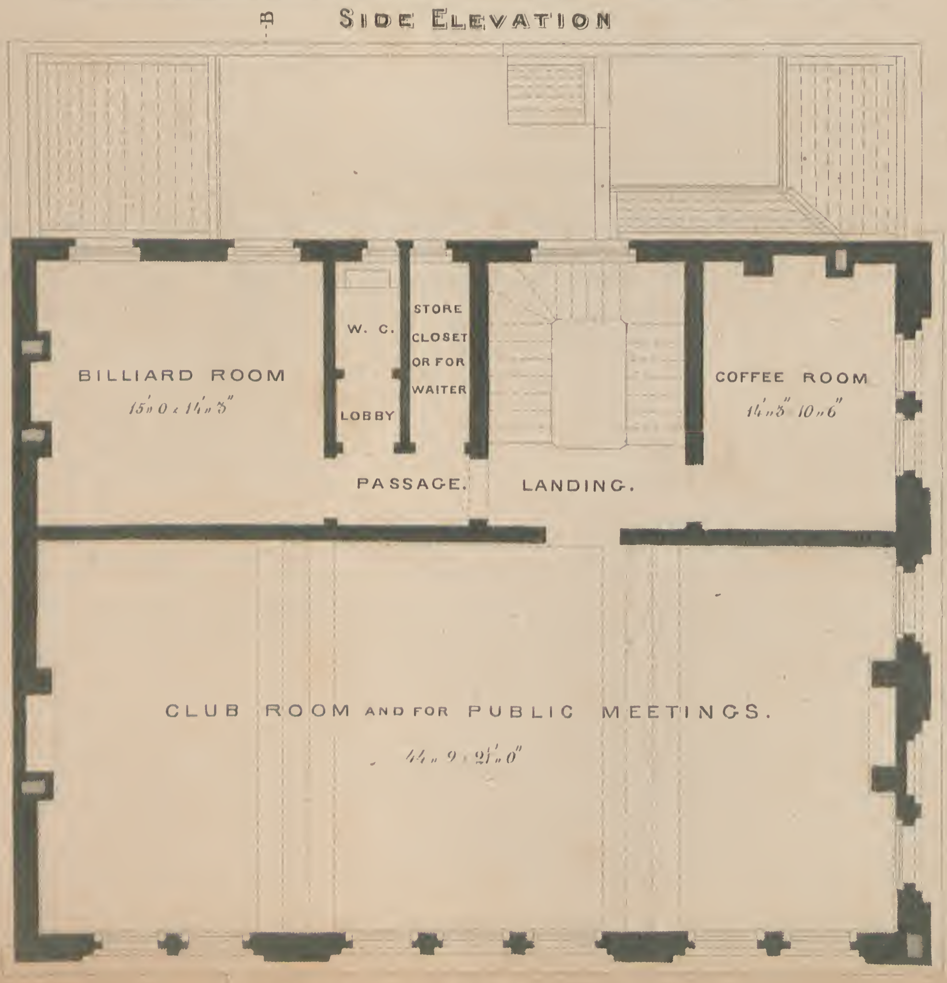
A H Payne sc.

SCALE OF 10 5 0 10 20 30 FEET

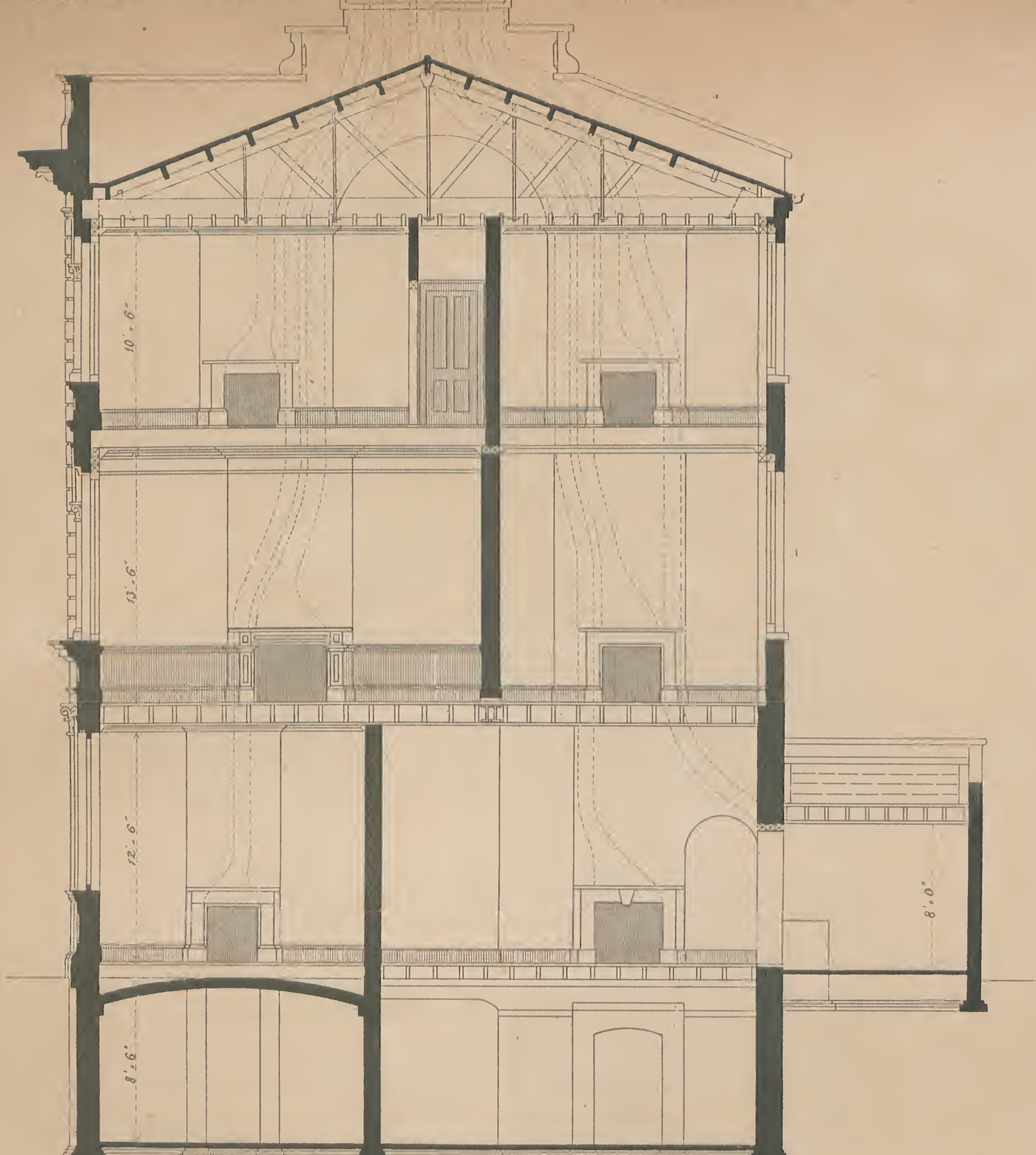
Design for a First Class Tavern.



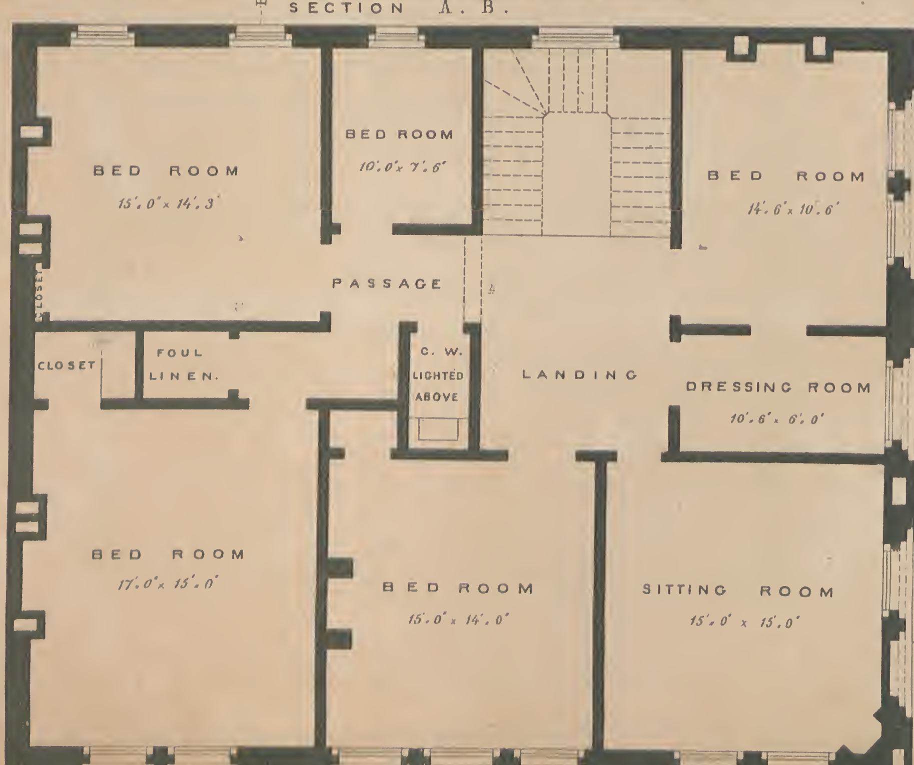
Side Elevation



Carbuck Inv. Plan of First Floor A.H.Payne sc.

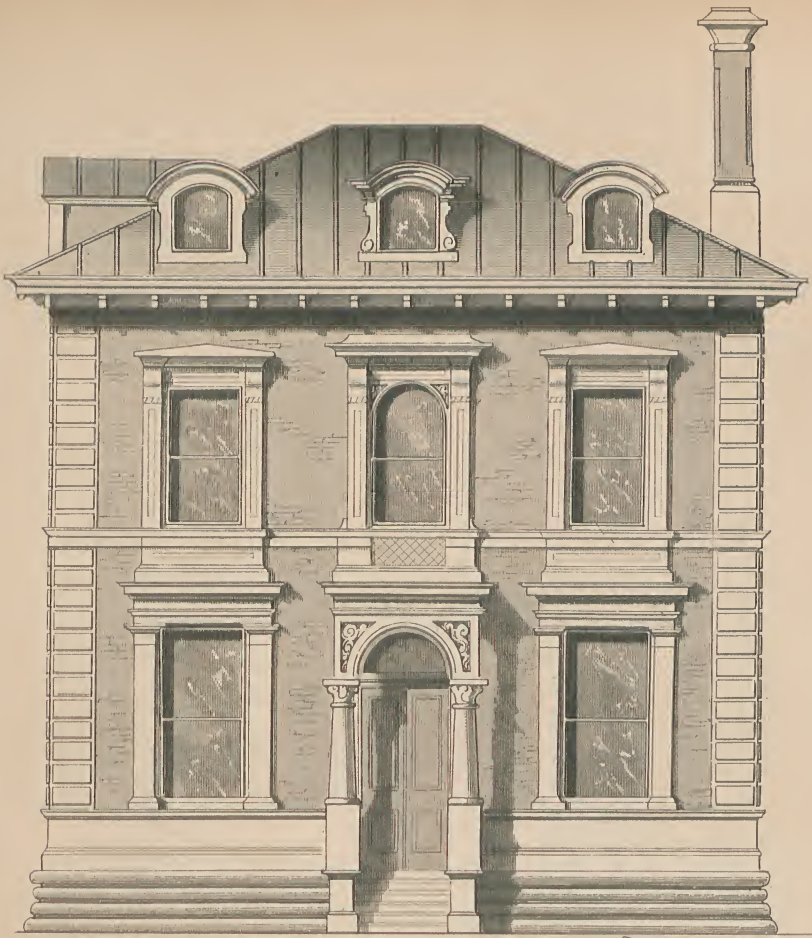


SECTION A. B.

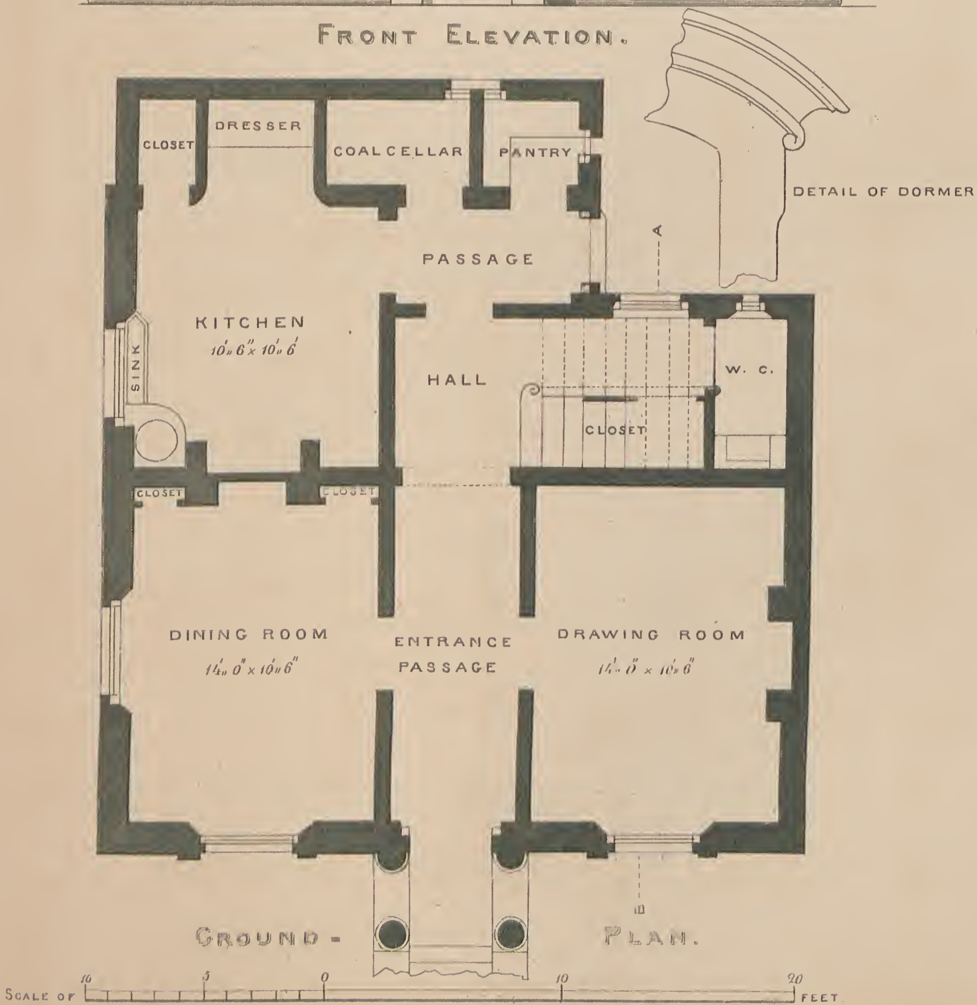


A. THIS WINDOW WILL PROBABLY BE CLOSED, WITH AN INSCRIPTION IN ITS PLACE.

PLAN OF SECOND FLOOR.

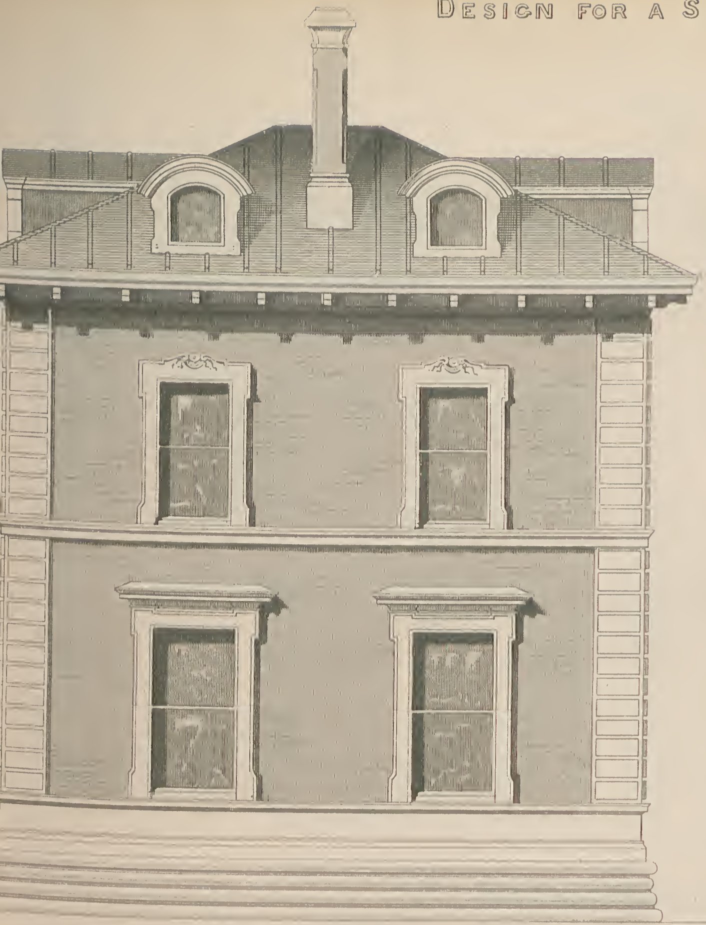


FRONT ELEVATION.

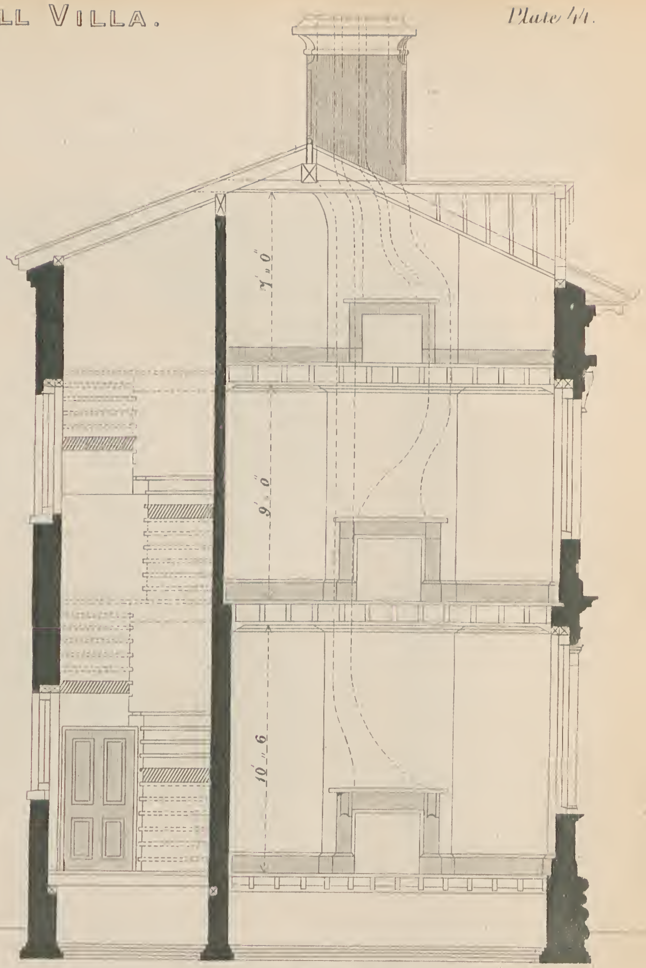


GROUND - PLAN.

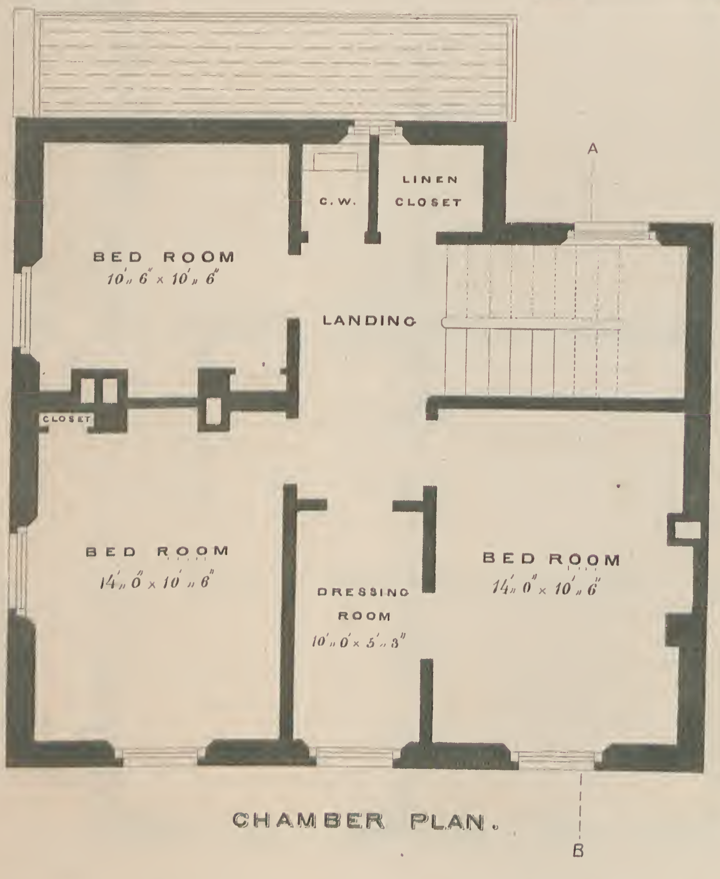
DESIGN FOR A SMALL VILLA.



SIDE ELEVATION.



SECTION A.B.



CHAMBER PLAN.

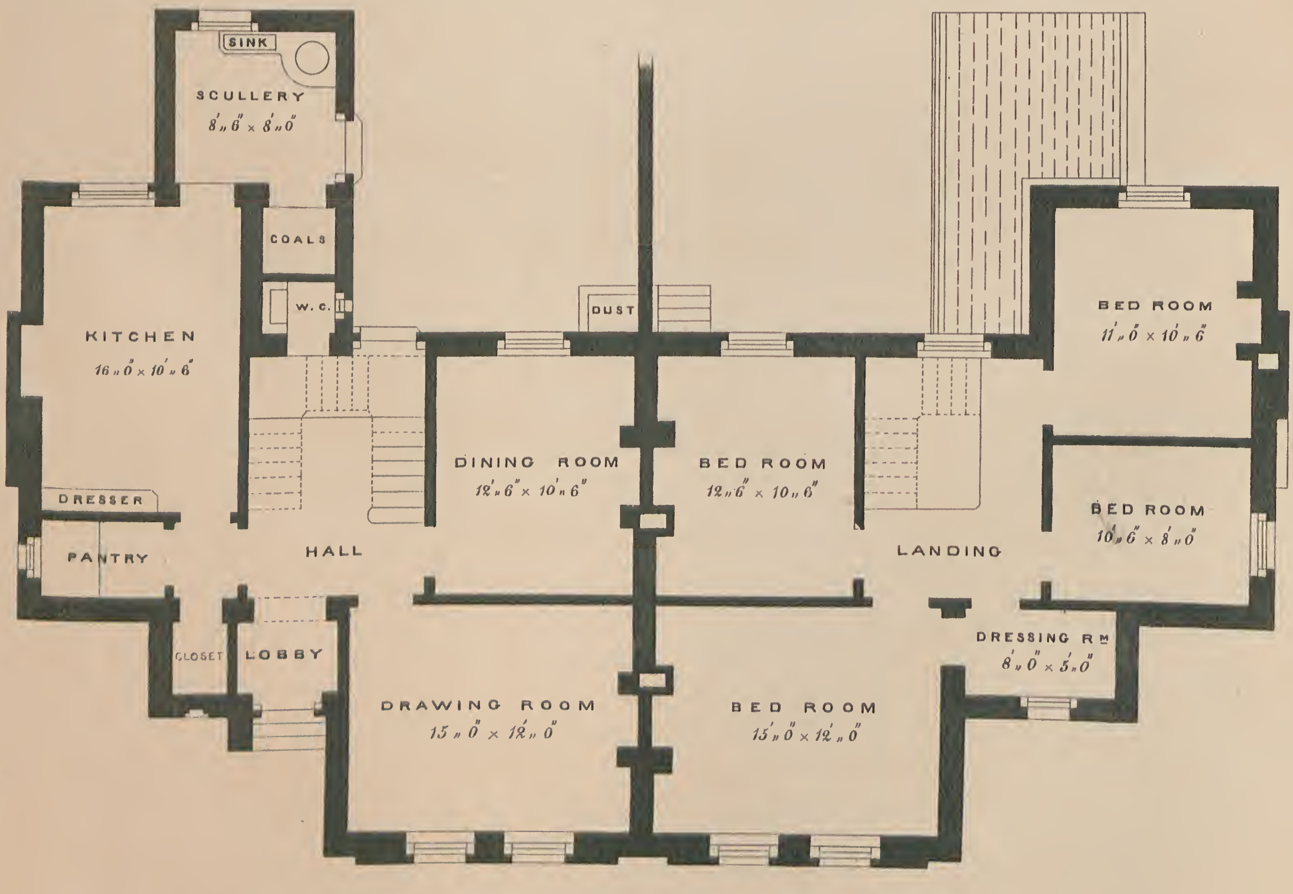
SCALE OF 10 5 0 10 20 FEET.

Tarbuck inv.

A. H. Payne sc.

Design for a Pair of Suburban Residences.

FRONT ELEVATION.



GROUND PLAN. CHAMBER PLAN.

SCALE OF 10 5 0 10 20 FEET.

PLAN FOR A FARM-HOUSE OR PARSONAGE.

Fig. 1

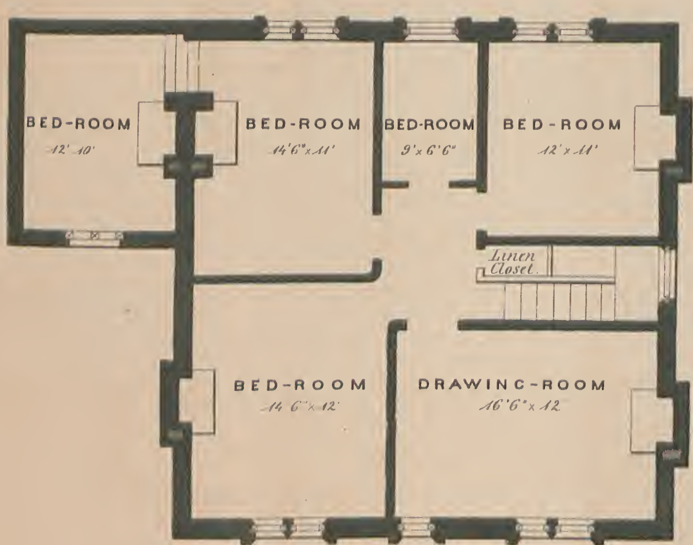
ELEVATION

10 9 8 7 6 5 4 3 2 1 0 10 20 30 *feet.*

SCALE TO SECTION

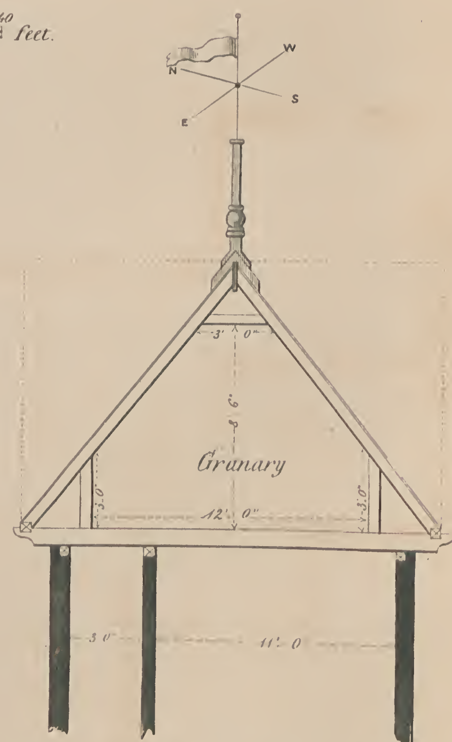
10 9 8 7 6 5 4 3 2 1 0 10 20 30 40 *feet.*

SCALE TO ELEVATION AND PLAN



BED-ROOM-FLOOR

Fig. 2.

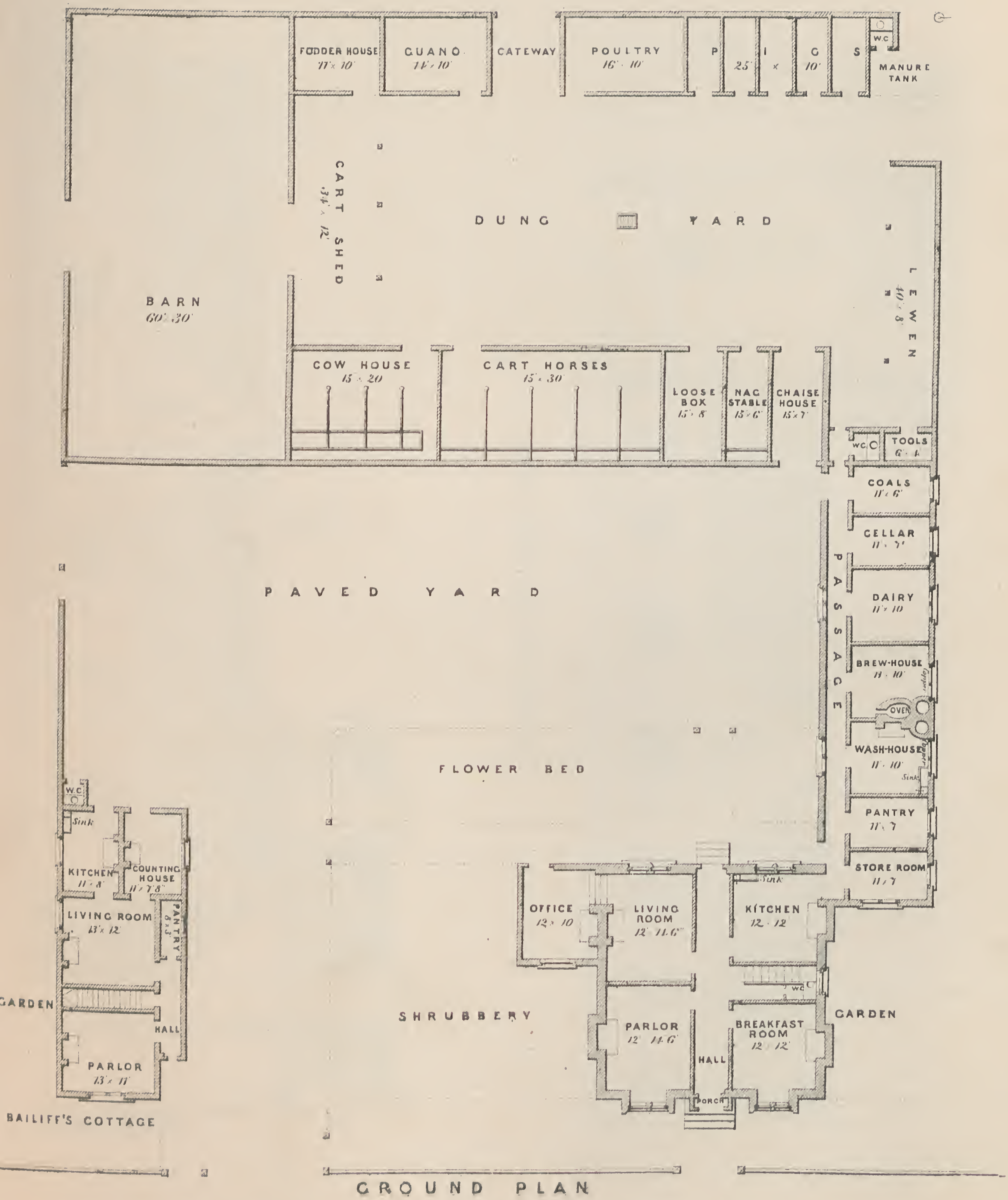


SECTION OF GRANARY OVER OFFICES

Fig. 3.

A H

FARM-HOUSE AND STEADING



GROUND PLAN

10 9 8 7 6 5 4 3 2 1 0 — 10 — 20 — 30 — 40 — 50 — 60 — 70 feet

SCALE OF FEET

FARM HOUSE OR PERSONAGE.

RIGHT HAND SIDE ELEVATION.

PLAN FOR BAILIFF'S COTTAGE.

Fig. 1

ELEVATION

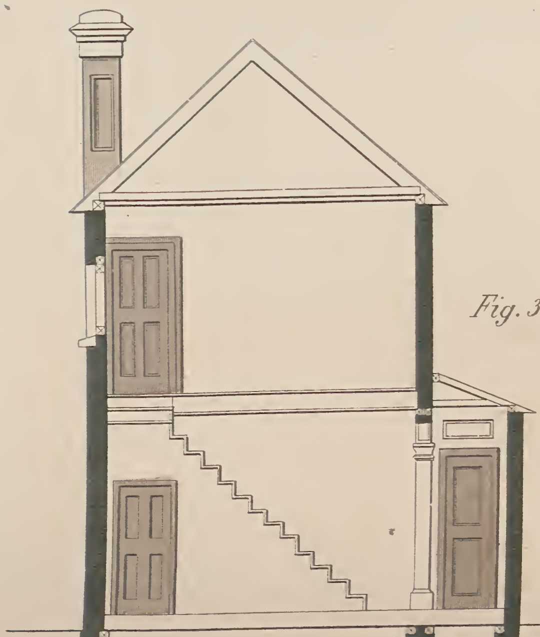
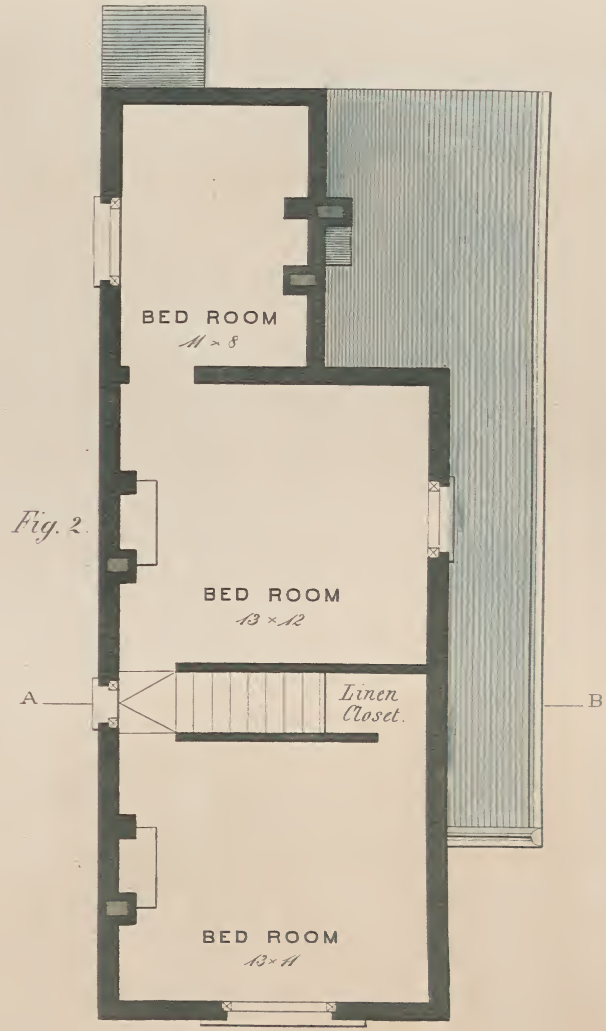


Fig. 3.

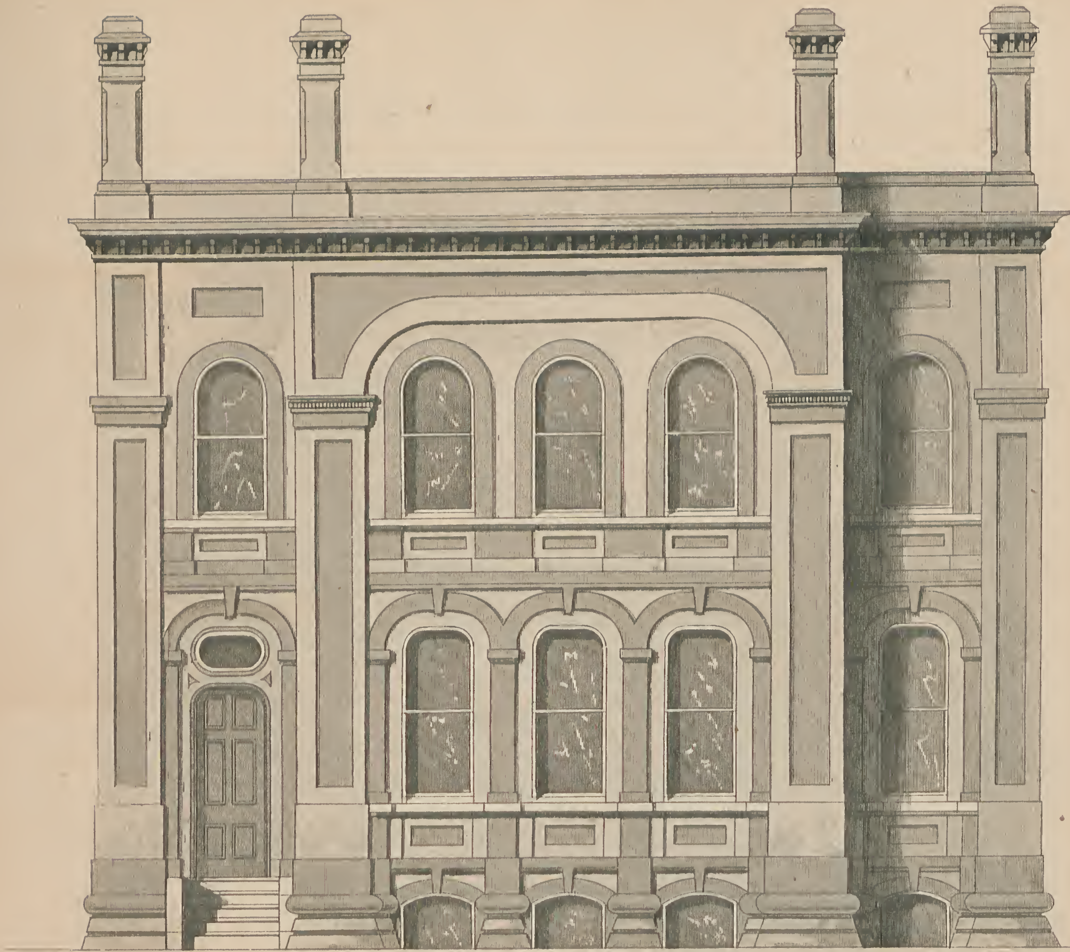
Fig. 2.



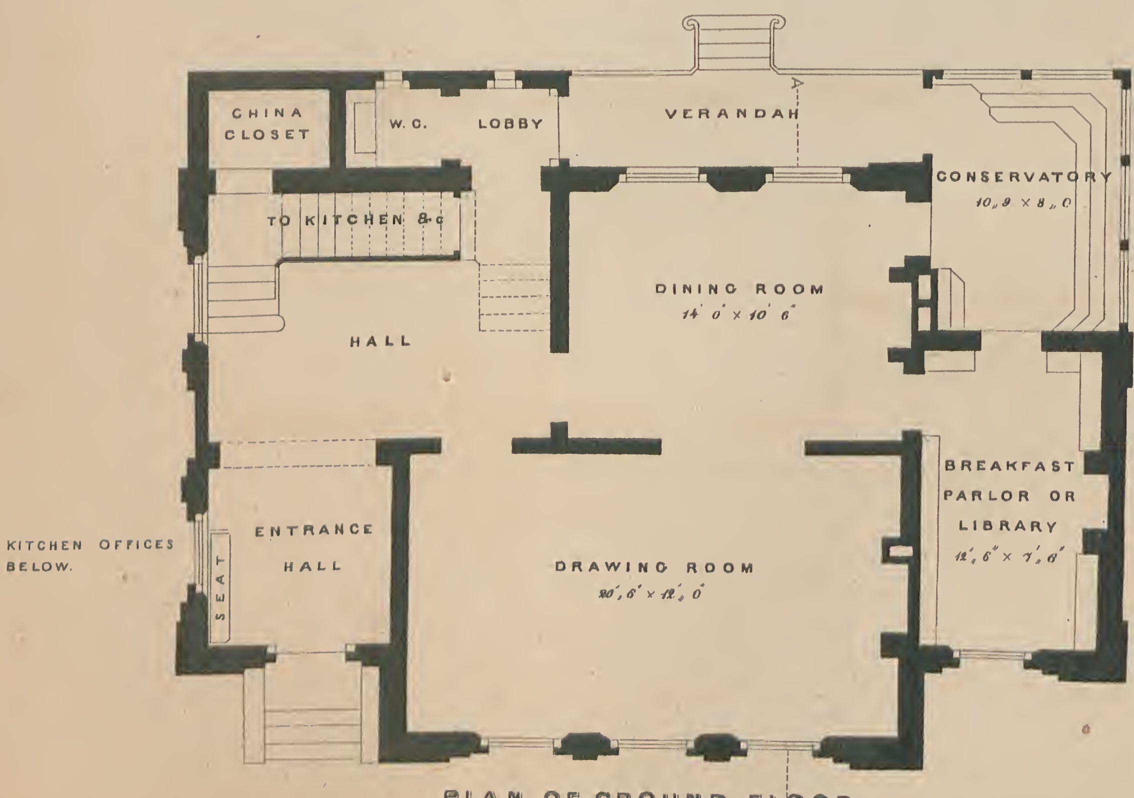
BED ROOM PLAN

Design for a Detached Town House.

With a Frontage of 40 Feet.



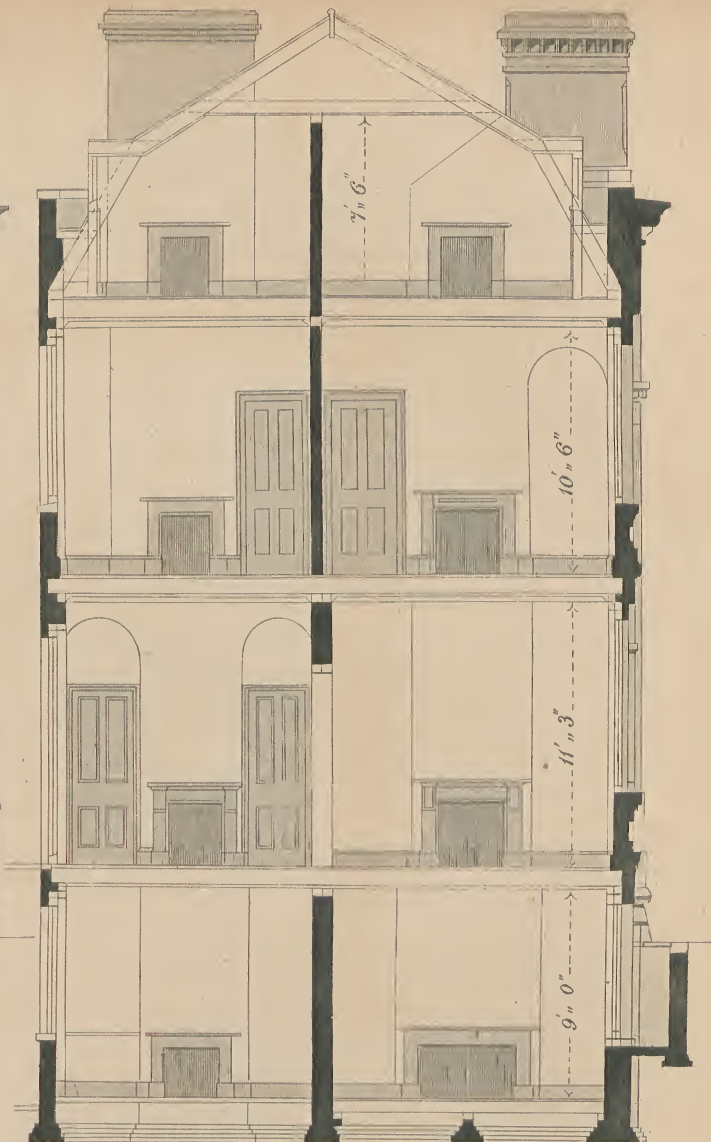
FRONT ELEVATION



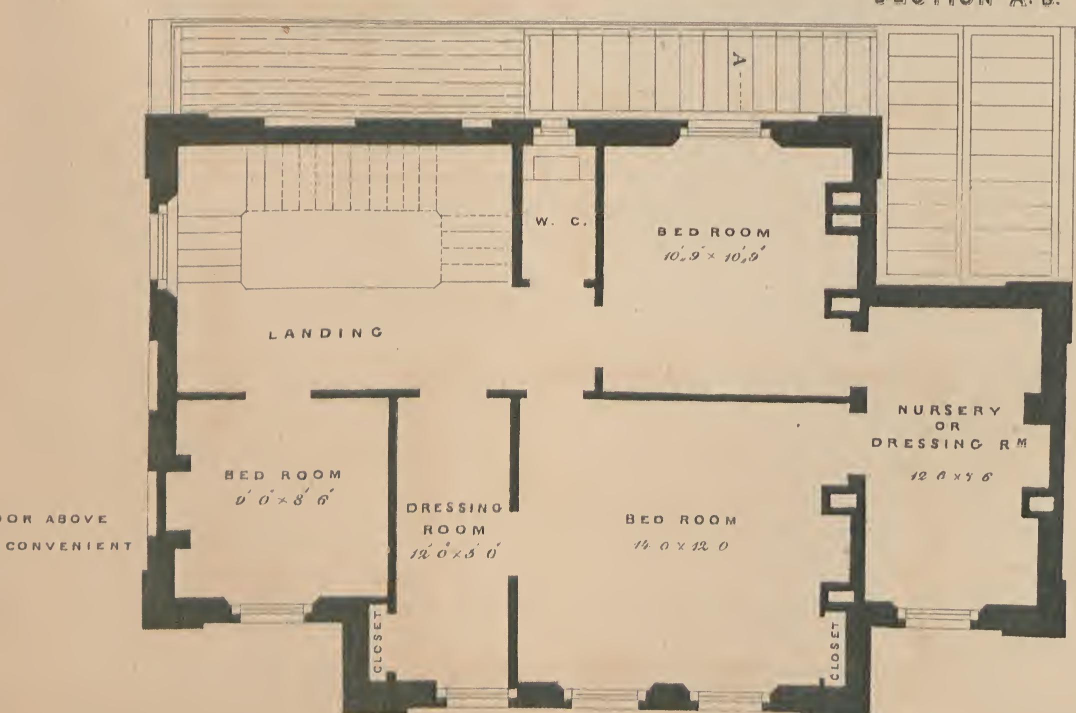
PLAN OF GROUND FLOOR

Scale of 10 5 0 10 Feet

SIDE ELEVATION



SECTION A. B.



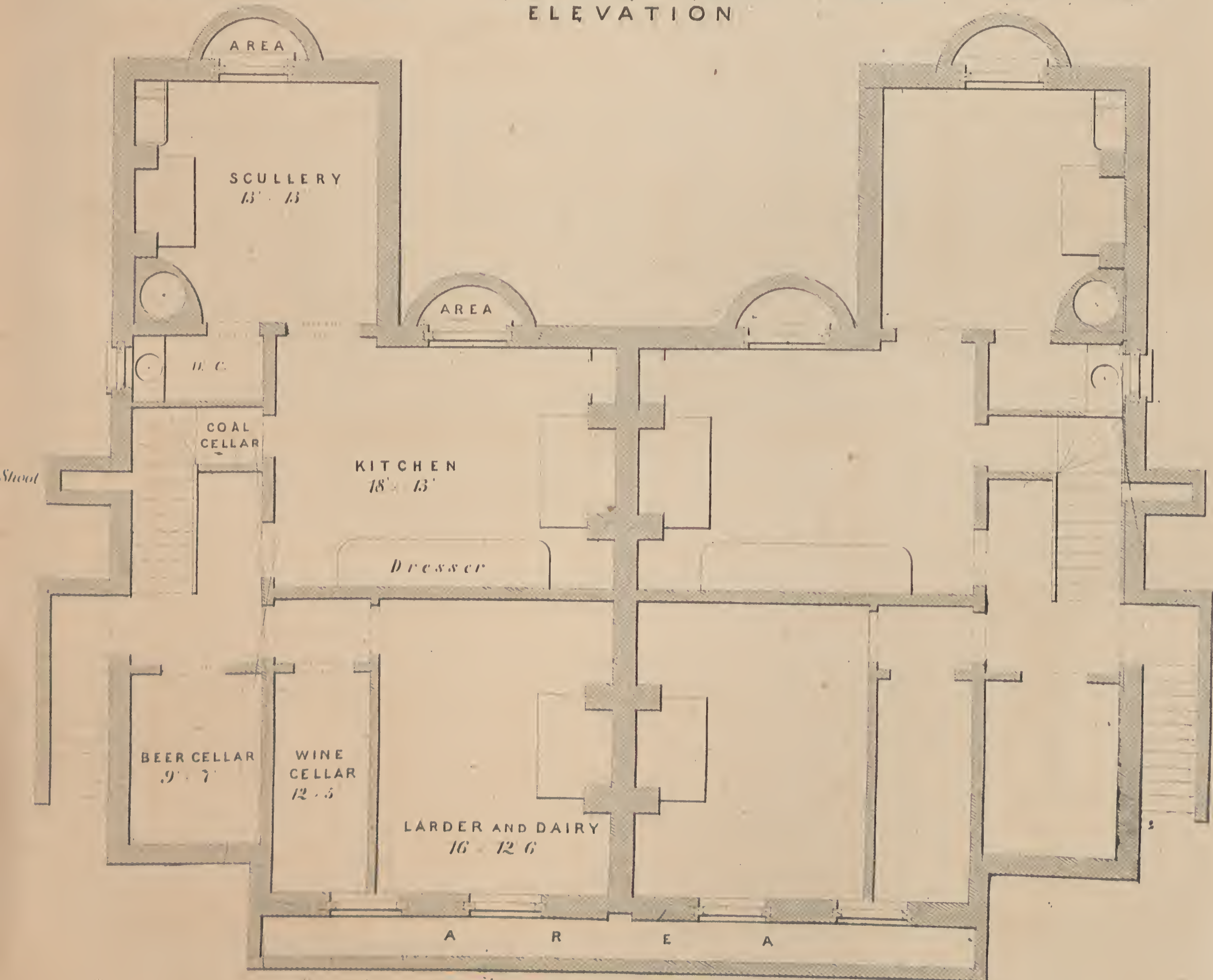
PLAN OF FIRST FLOOR

SCALE OF 10 5 0 10 FEET

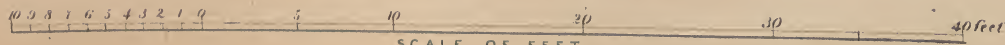
L Tarbuck inv

PAIR OF SECOND RATE HOUSES

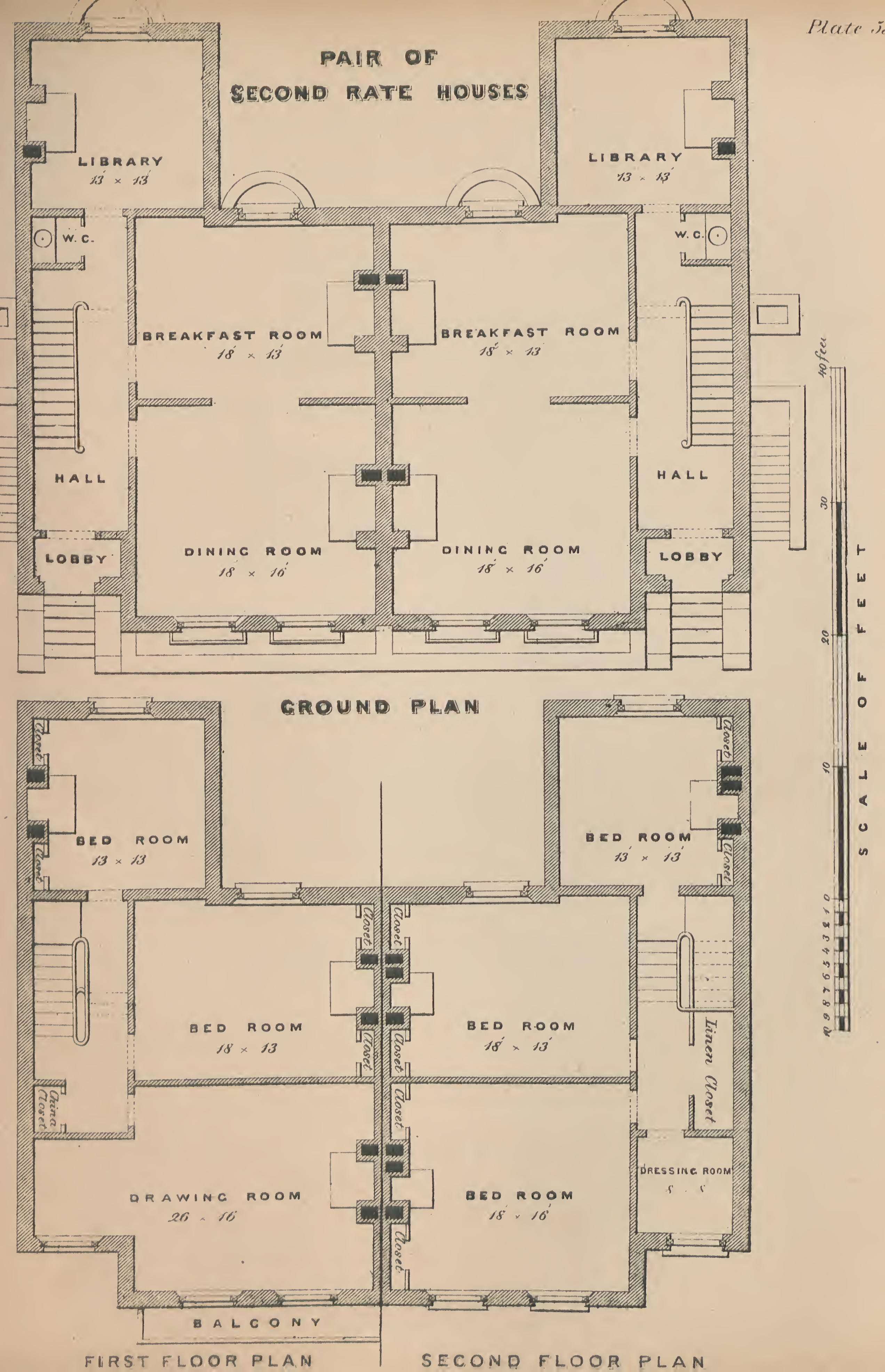
ELEVATION



BASEMENT PLAN.

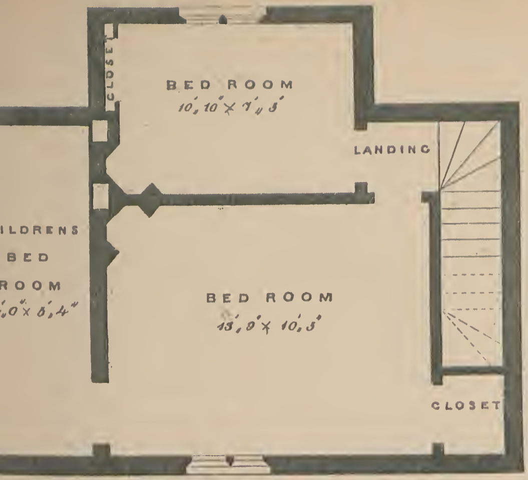


SCALE OF FEET

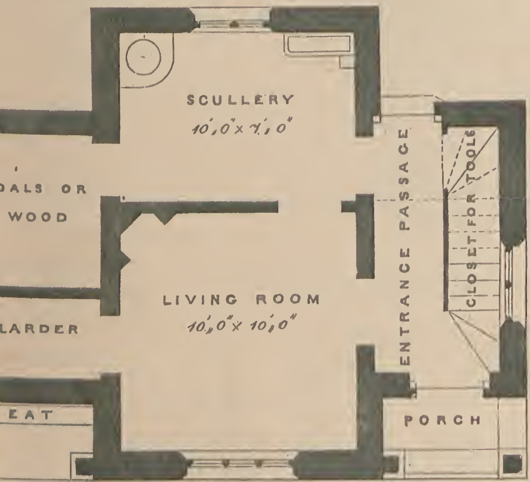


PAIR OF SECOND RATE HOUSES
LIBRARY 13 × 13
LIBRARY 13 × 13
W. C.
W. C.
BREAKFAST ROOM 18 × 13
BREAKFAST ROOM 18 × 13
HALL
HALL
DINING ROOM 18 × 16
DINING ROOM 18 × 16
LOBBY
LOBBY
GROUND PLAN
Closet
BED ROOM 13 × 13
BED ROOM 13 × 13
BED ROOM 18 × 13
BED ROOM 18 × 13
China Closet
Linen Closet
DRESSING ROOM
DRAWING ROOM 26 × 16
BED ROOM 18 × 16
BALCONY
FIRST FLOOR PLAN
SECOND FLOOR PLAN
SCALE OF FEET
10 9 8 7 6 5 4 3 2 1 0
10
20
30
40 feet

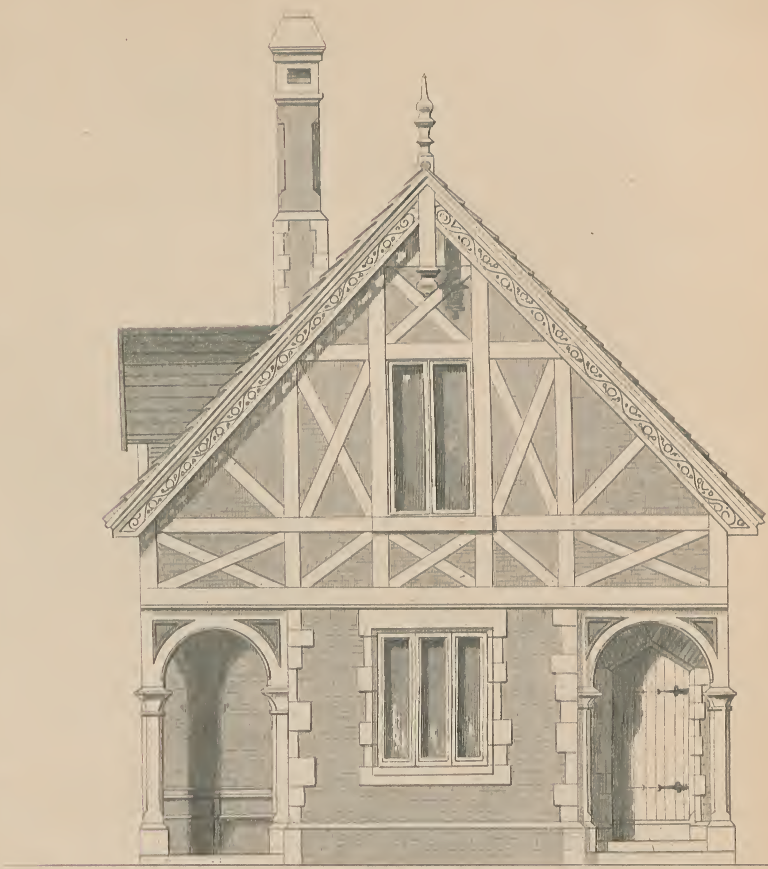
Designs for Lodges or Small Cottages



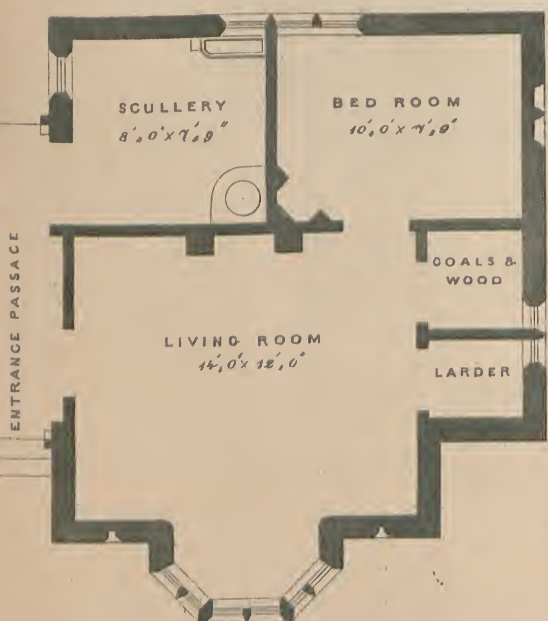
CHAMBER PLAN



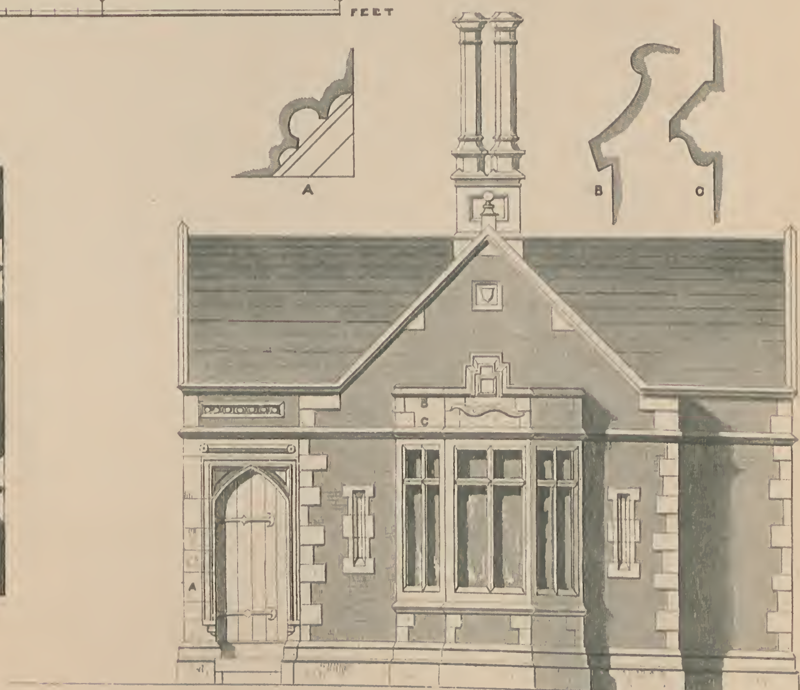
GROUND PLAN



PRINCIPAL ELEVATION



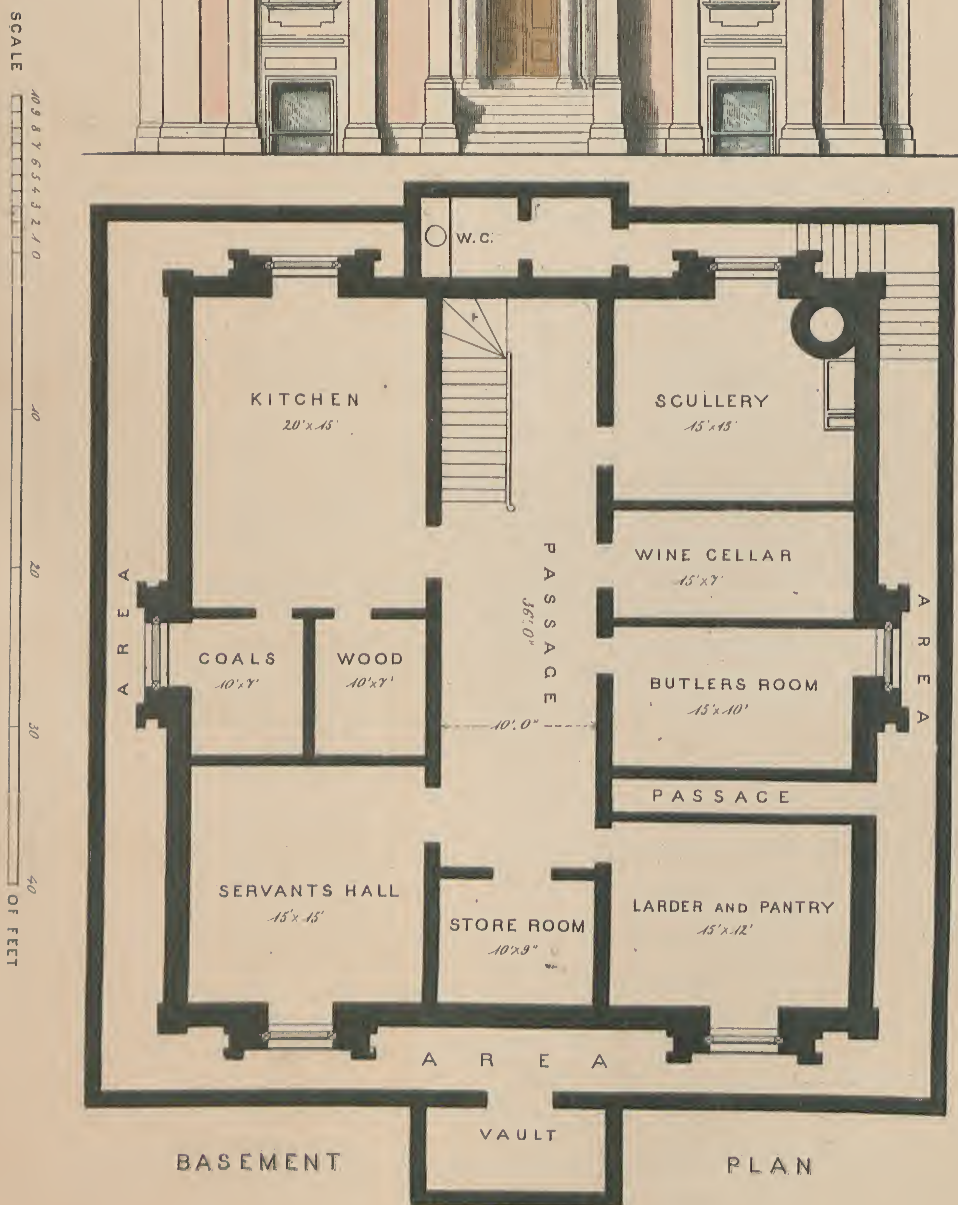
PLAN



PRINCIPAL ELEVATION

FRONT ELEVATION.

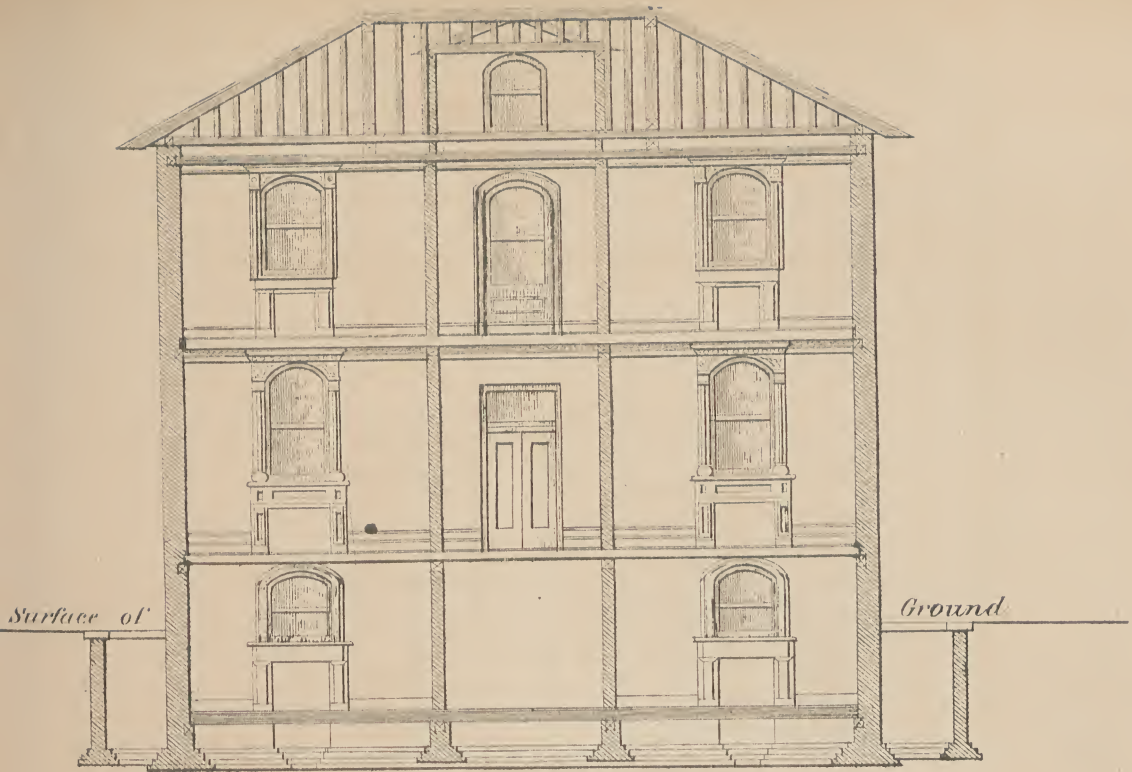
Fig. 1.



BASEMENT PLAN

Fig. 2.

A H. Payne sc.



Section of Front Wall shewing Windows over Fire Places

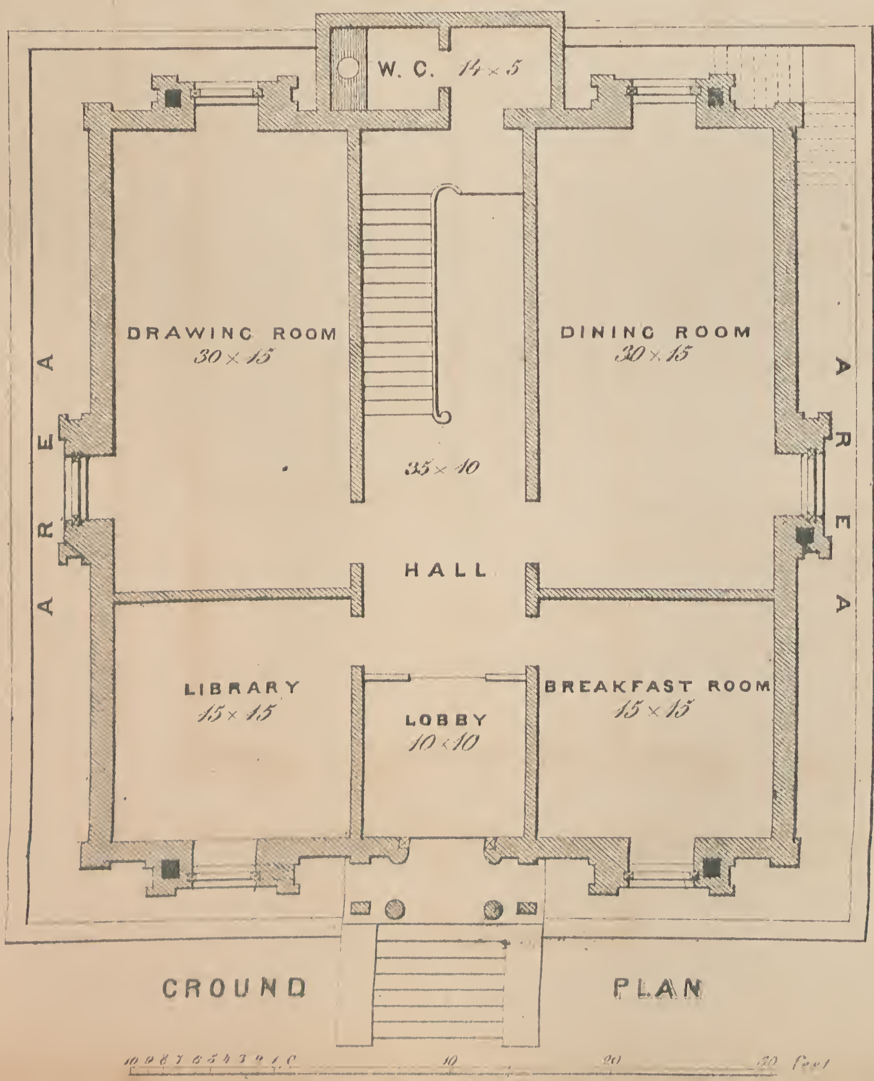
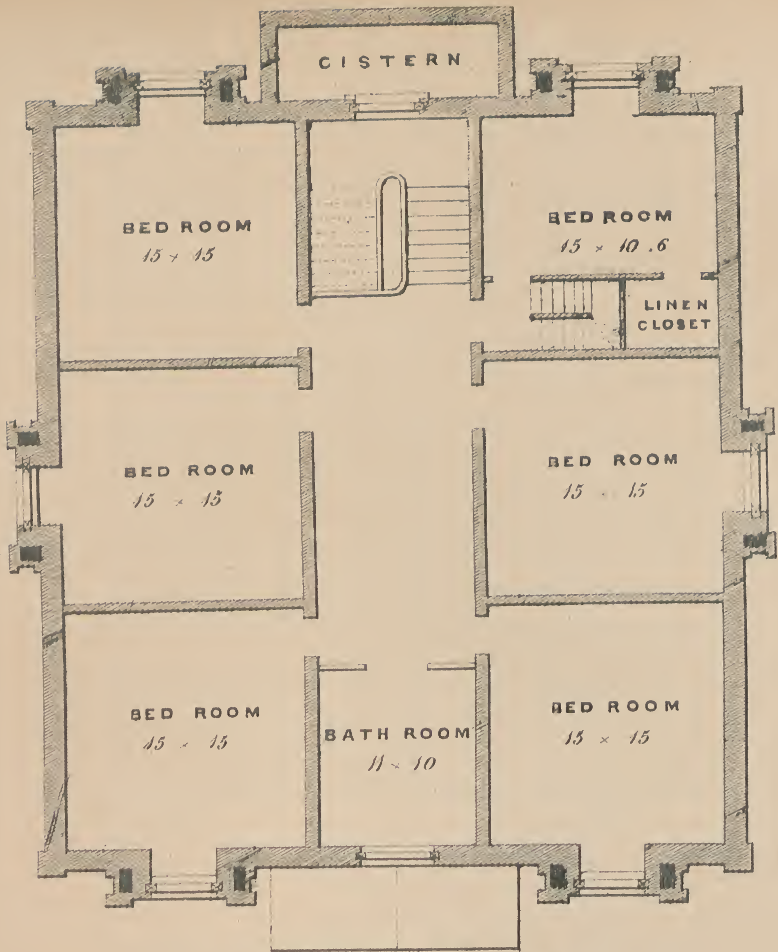


Fig 1

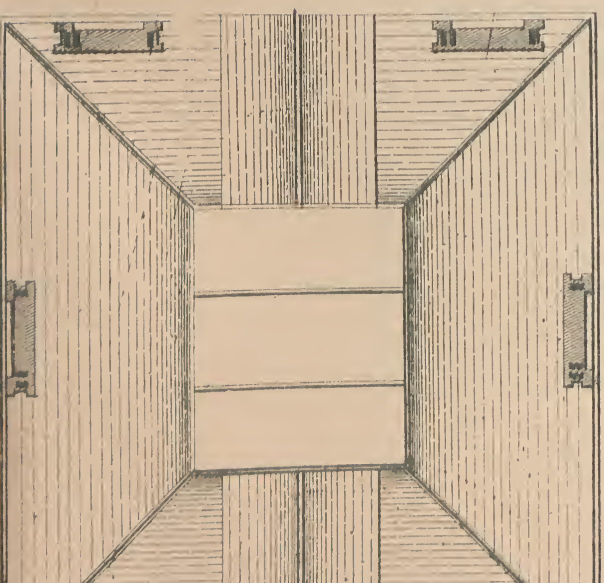


FIRST FLOOR PLAN

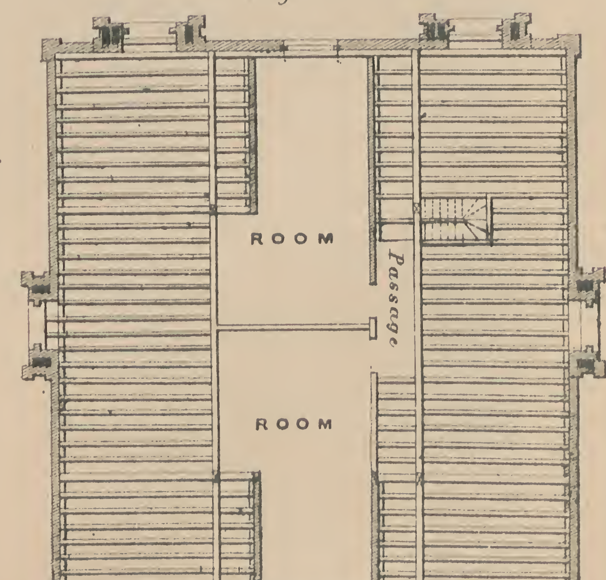
10 9 8 7 6 5 4 3 2 1 0 10 20 30 feet

SCALE to Fig 1

Fig 2



PLAN OF ROOF



PLAN OF ROOMS IN ROOF

10 9 8 7 6 5 4 3 2 1 0 10 20 30 40 feet

SCALE to Fig 2 AND PLAN OF ROOF

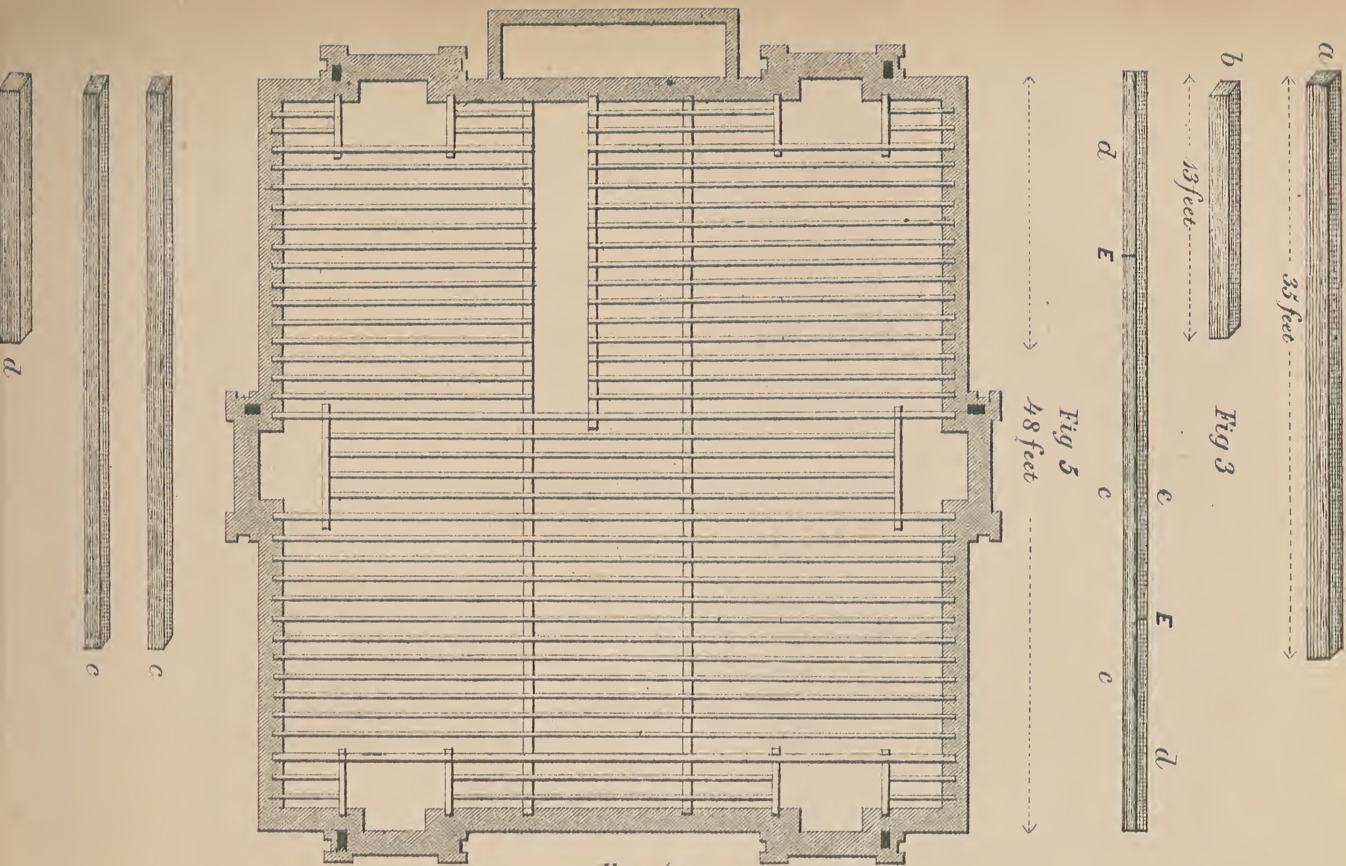
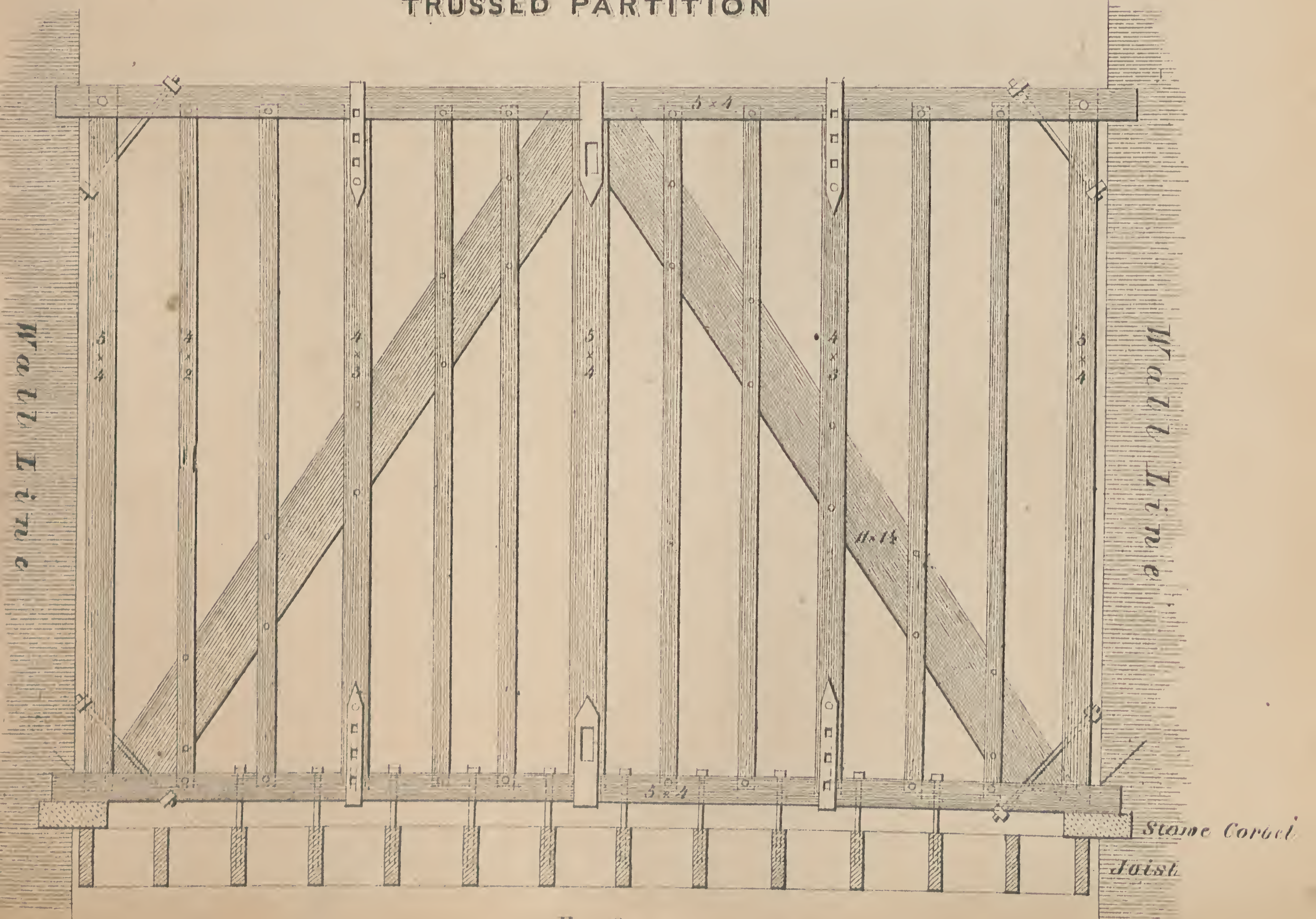
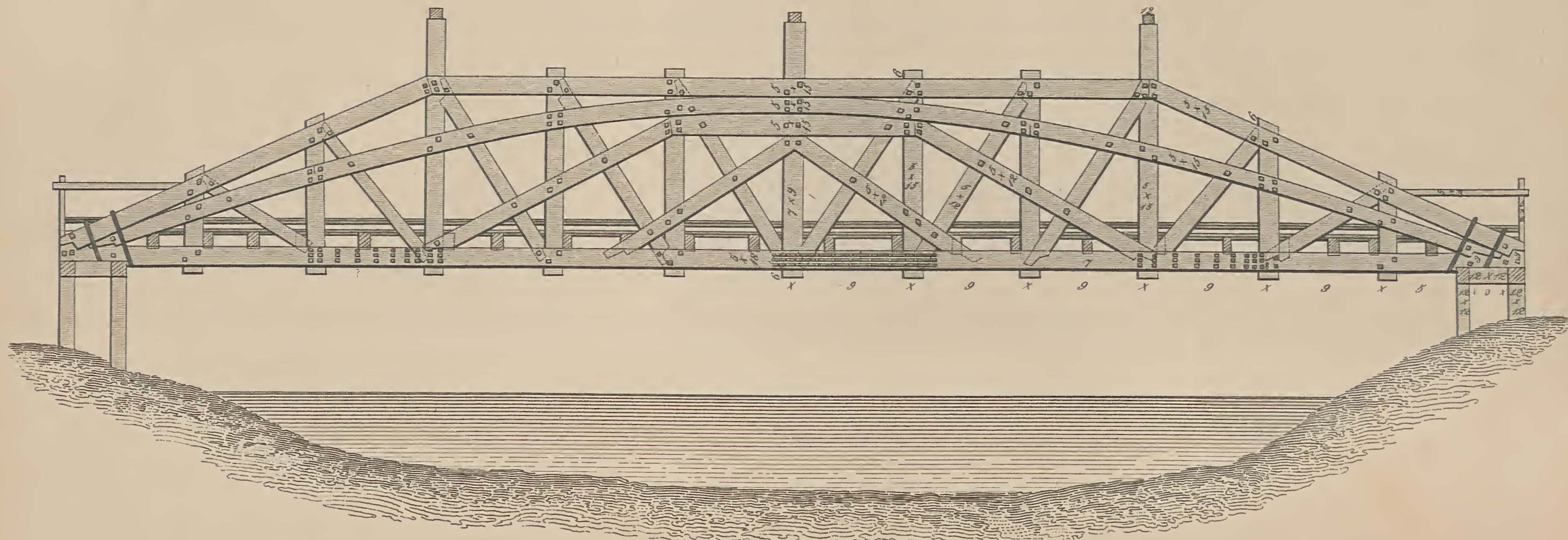


Fig 1

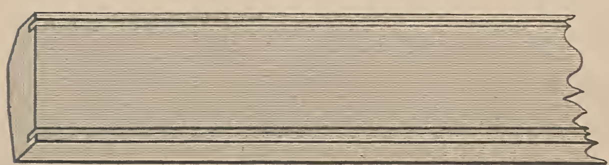
TRUSSED PARTITION



BRIDGE OF ONE SPAN OF 100 FEET OVER THE MOHAWK RIVER NEAR THE CITY OF ROME U. S.



SPAN 100 FEET.

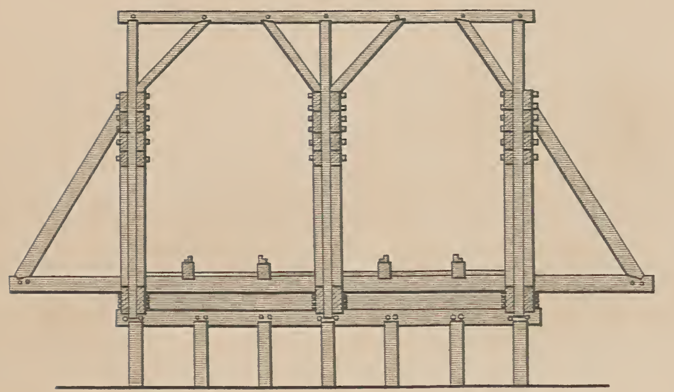


COPING UNDERSIDE.

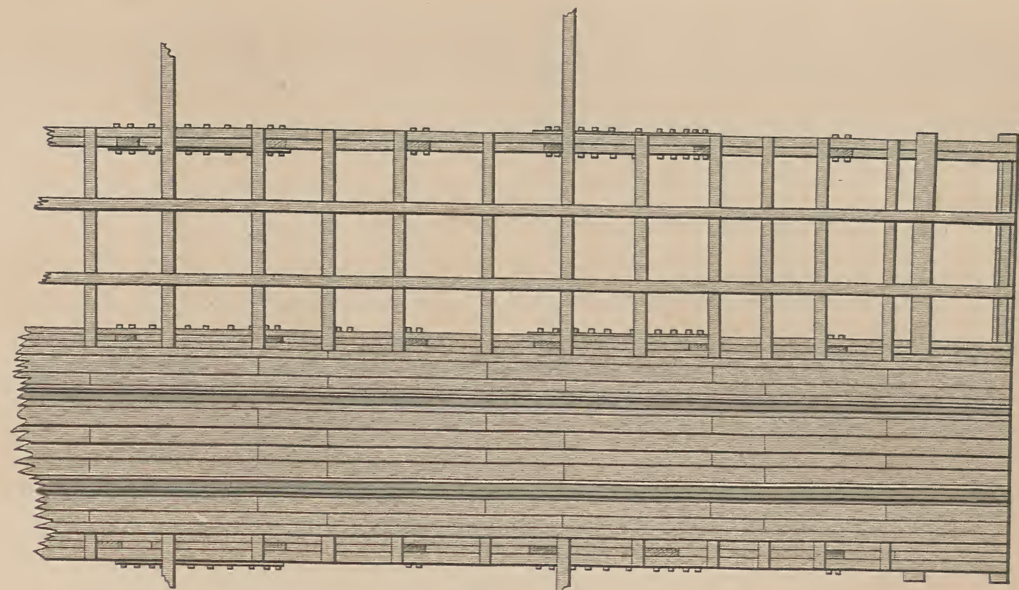
COPING PLANK.

B. F. Isherwood C. E. del

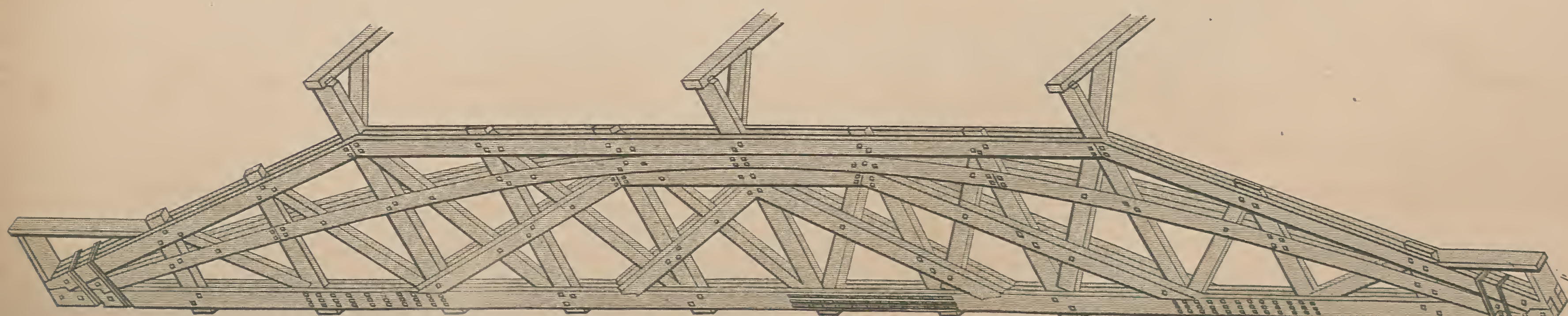
A. H. Payne



SECTION.

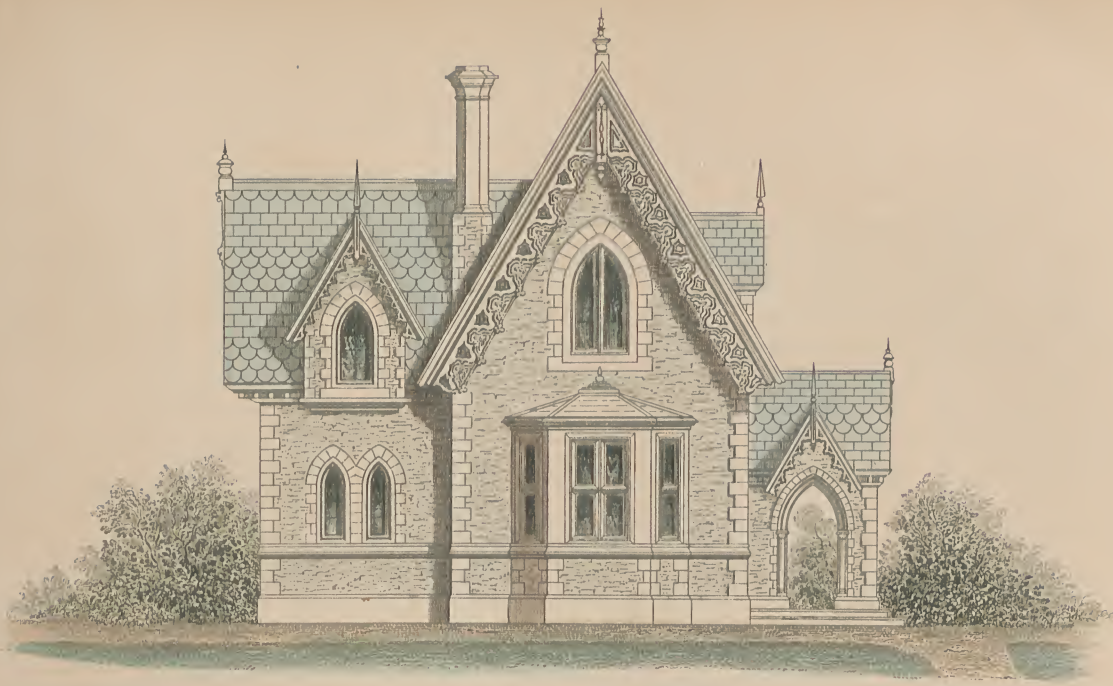


PLAN.



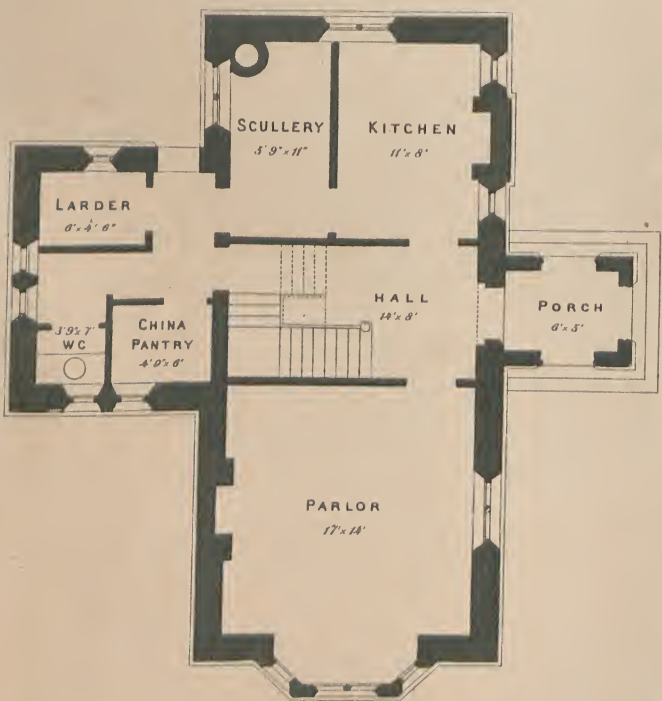
SPAN 100 FEET

ISOMETRICAL PROJECTION.

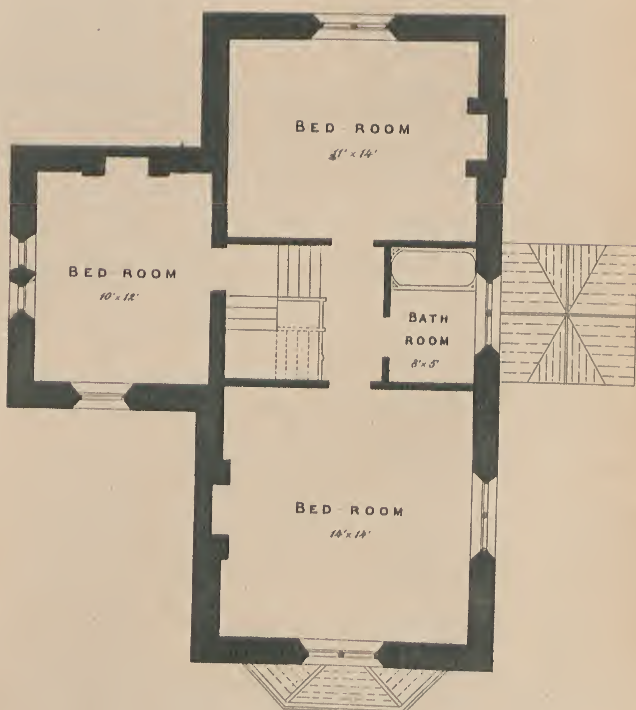


ELEVATION.

GROUND PLAN.



CHAMBER PLAN.



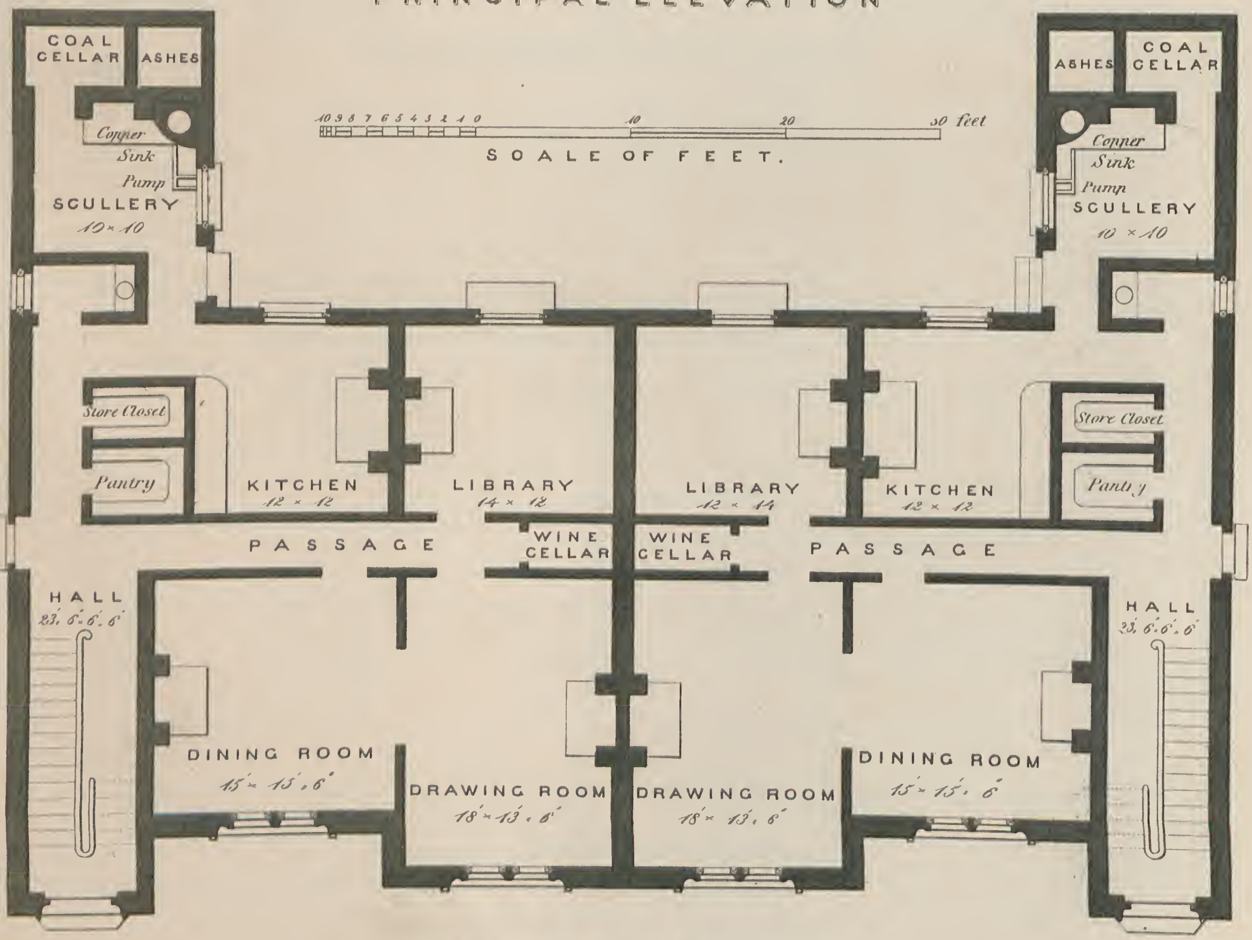
SCALE  OF FEET.

S. Brookes

A. H. Payne sc.

PLAN AND ELEVATION
FOR A
PAIR OF ORNAMENTAL VILLAS.

PRINCIPAL ELEVATION

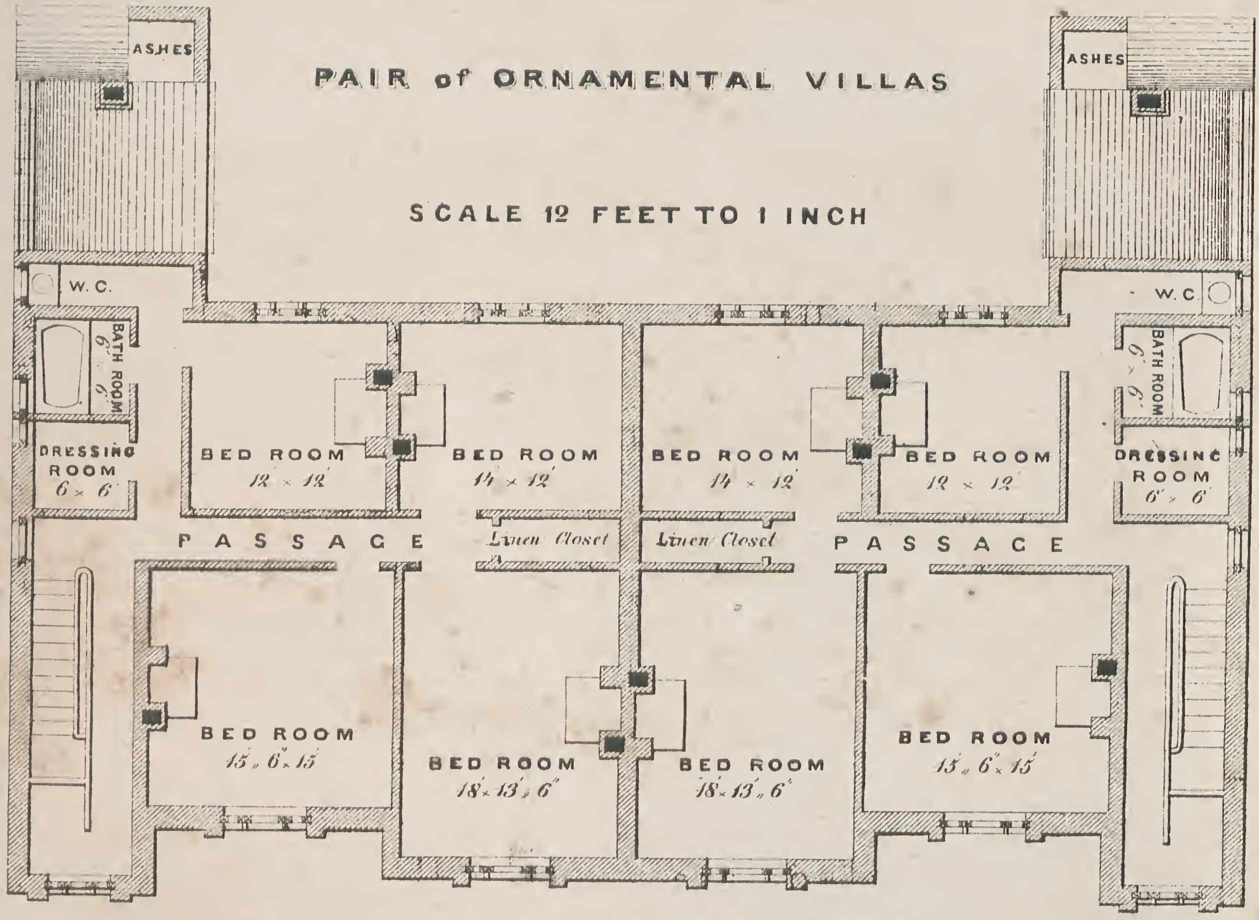


GROUND PLAN

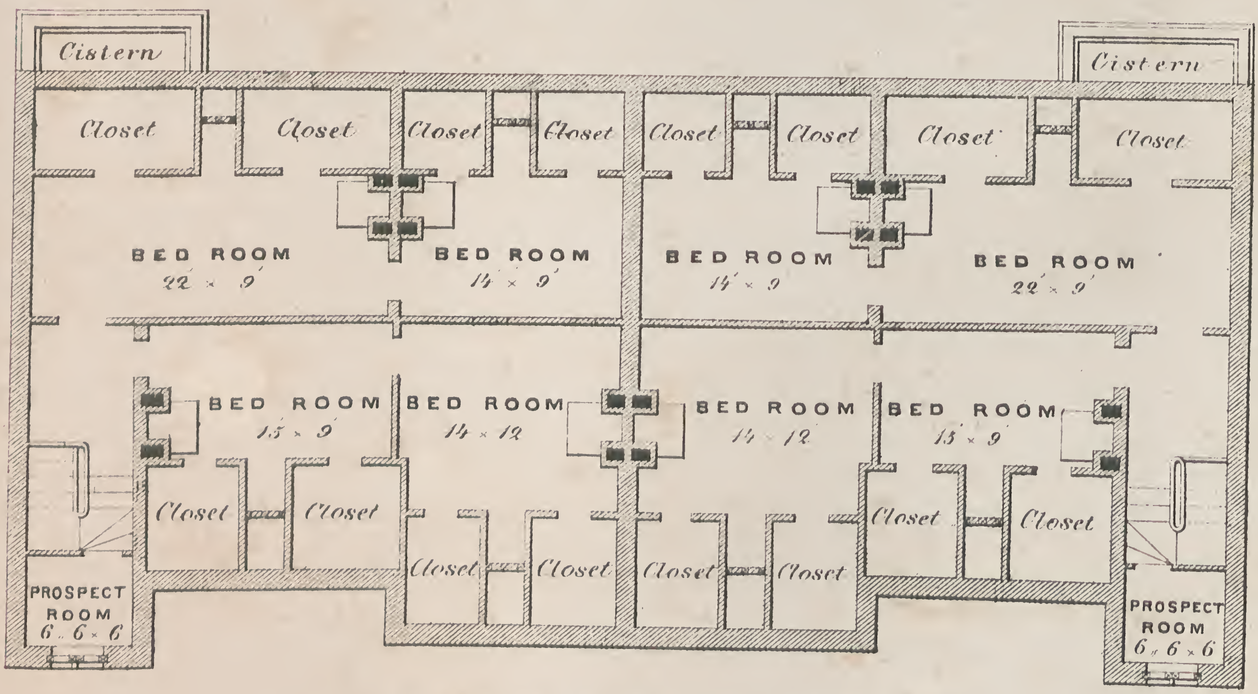
A. H. Payne sc.

PAIR of ORNAMENTAL VILLAS

SCALE 12 FEET TO 1 INCH



PLAN of BED ROOM FLOOR

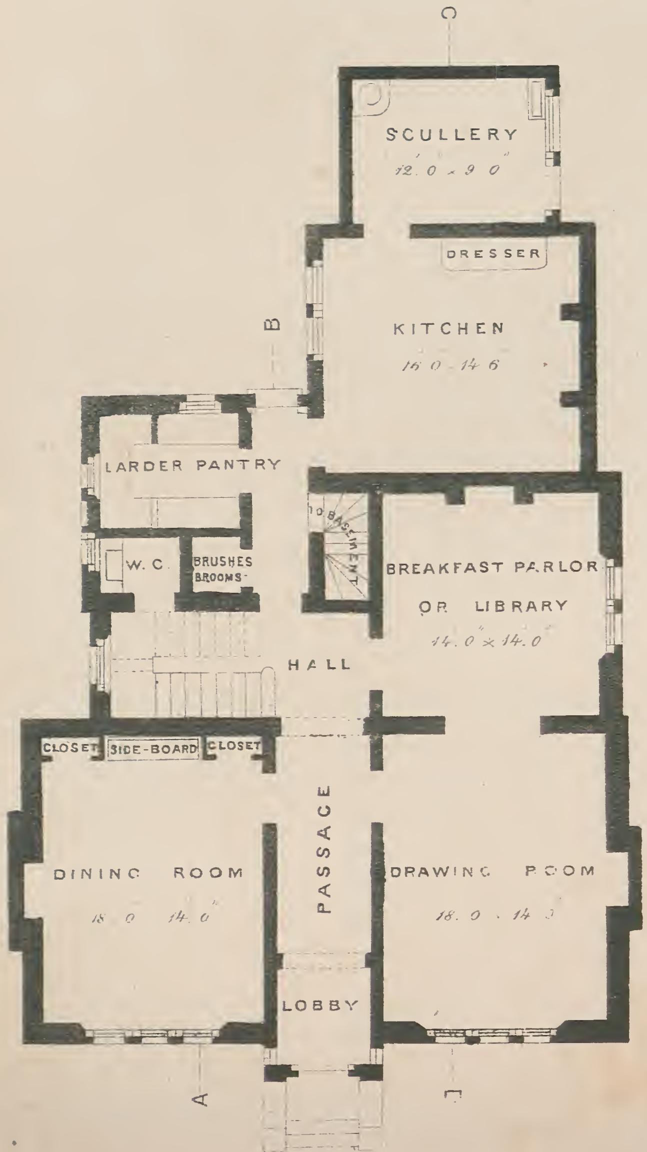


PLAN of ATTIC FLOOR

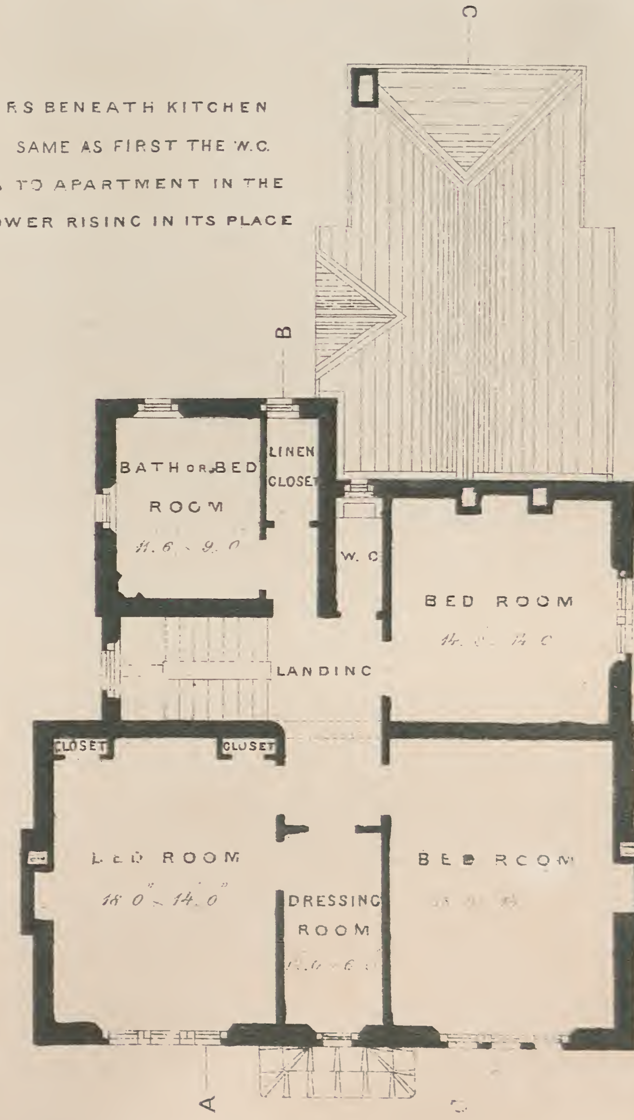
DESIGN FOR A DETACHED VILLA

ADAPTED FOR A FRONTAGE OF 40 FEET

COAL & WINE CELLARS BENEATH KITCHEN
SECOND FLOOR THE SAME AS FIRST THE W.C.
OMITTED & STAIRS TO APARTMENT IN THE
UPPER PART OF TOWER RISING IN ITS PLACE

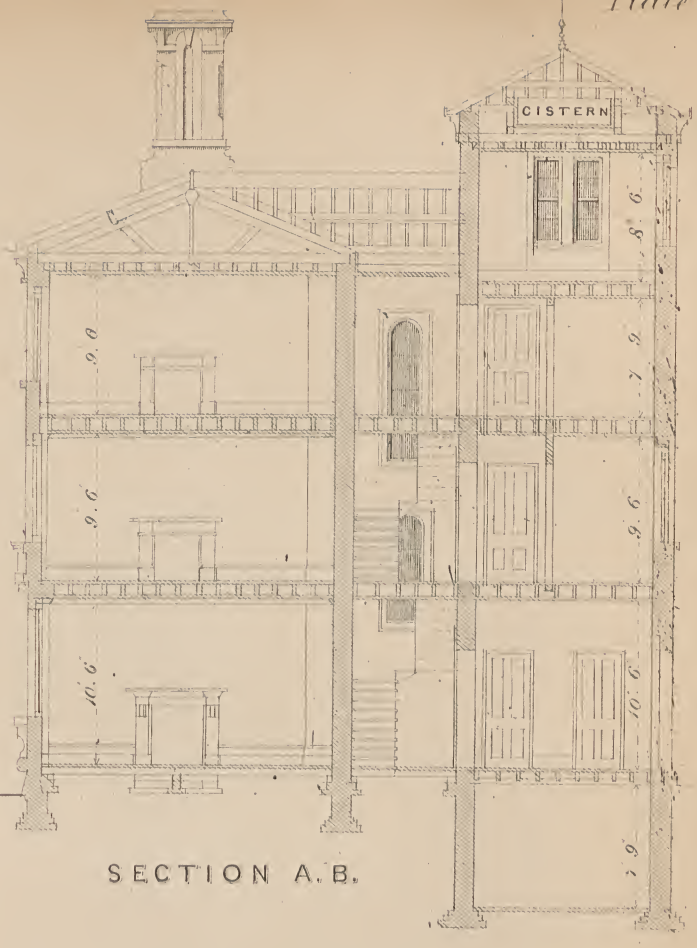


PLAN OF PRINC



PLAN OF FIRST FLOOR

FRONT ELEVATION



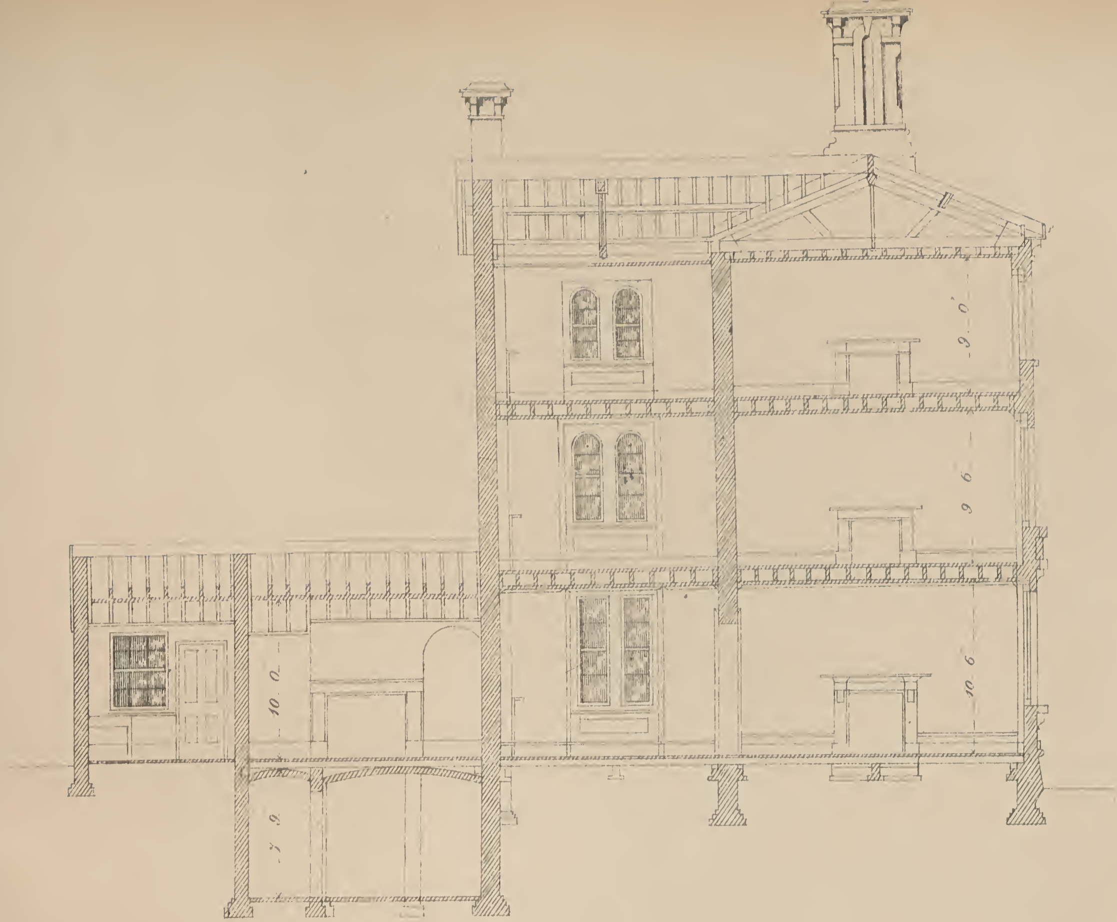
SECTION A.B.

SIDE ELEVATION

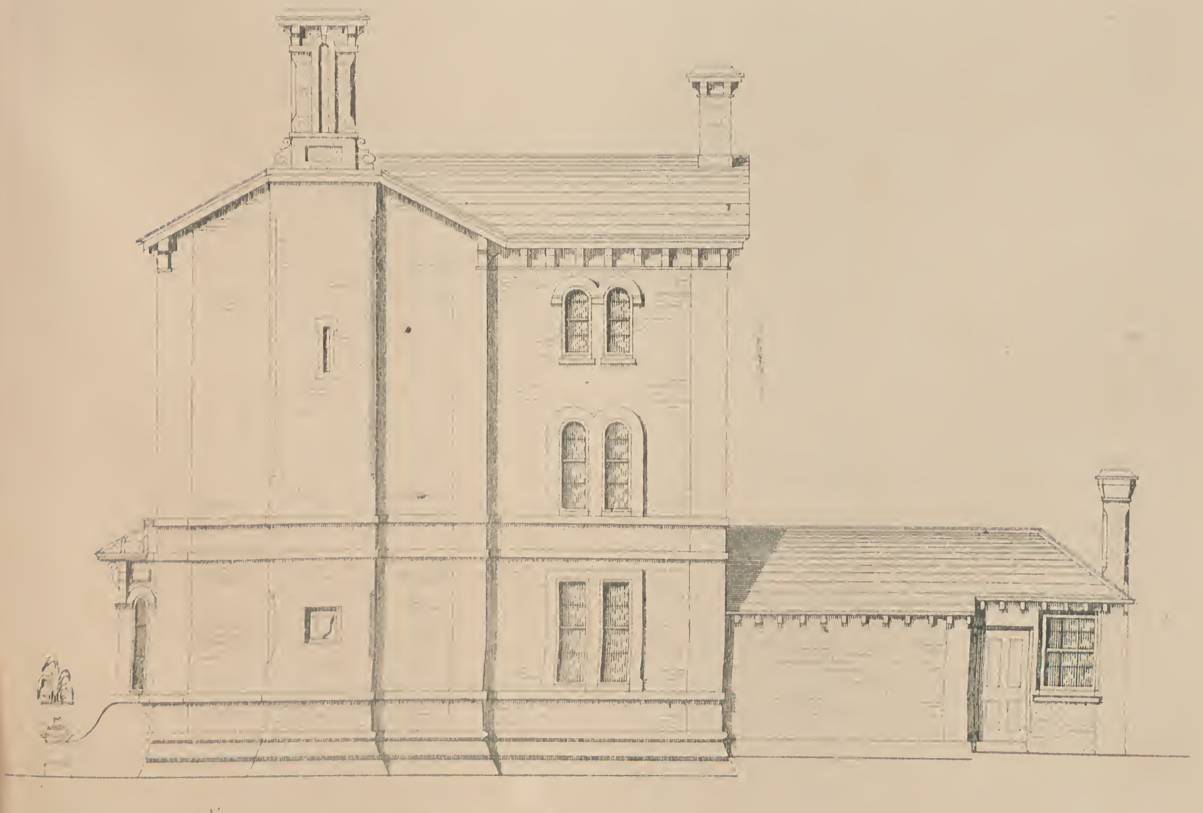
SCALE OF 10 0 10 20 30 FEET

rbuck des

A. H.

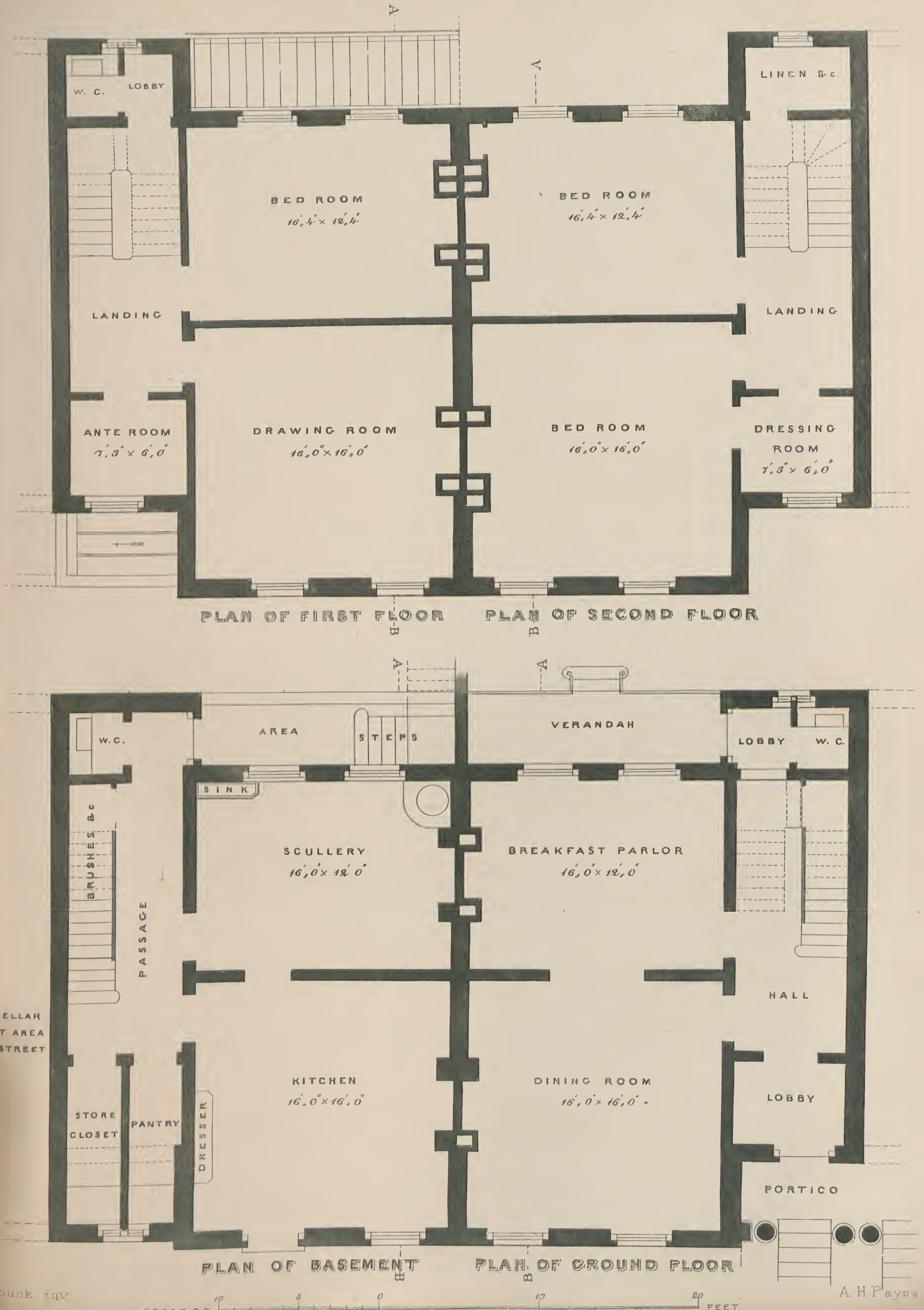


SECTION C.D.



SIDE ELEVATION

SCALE OF 10 5 0 10 20 30 FEET

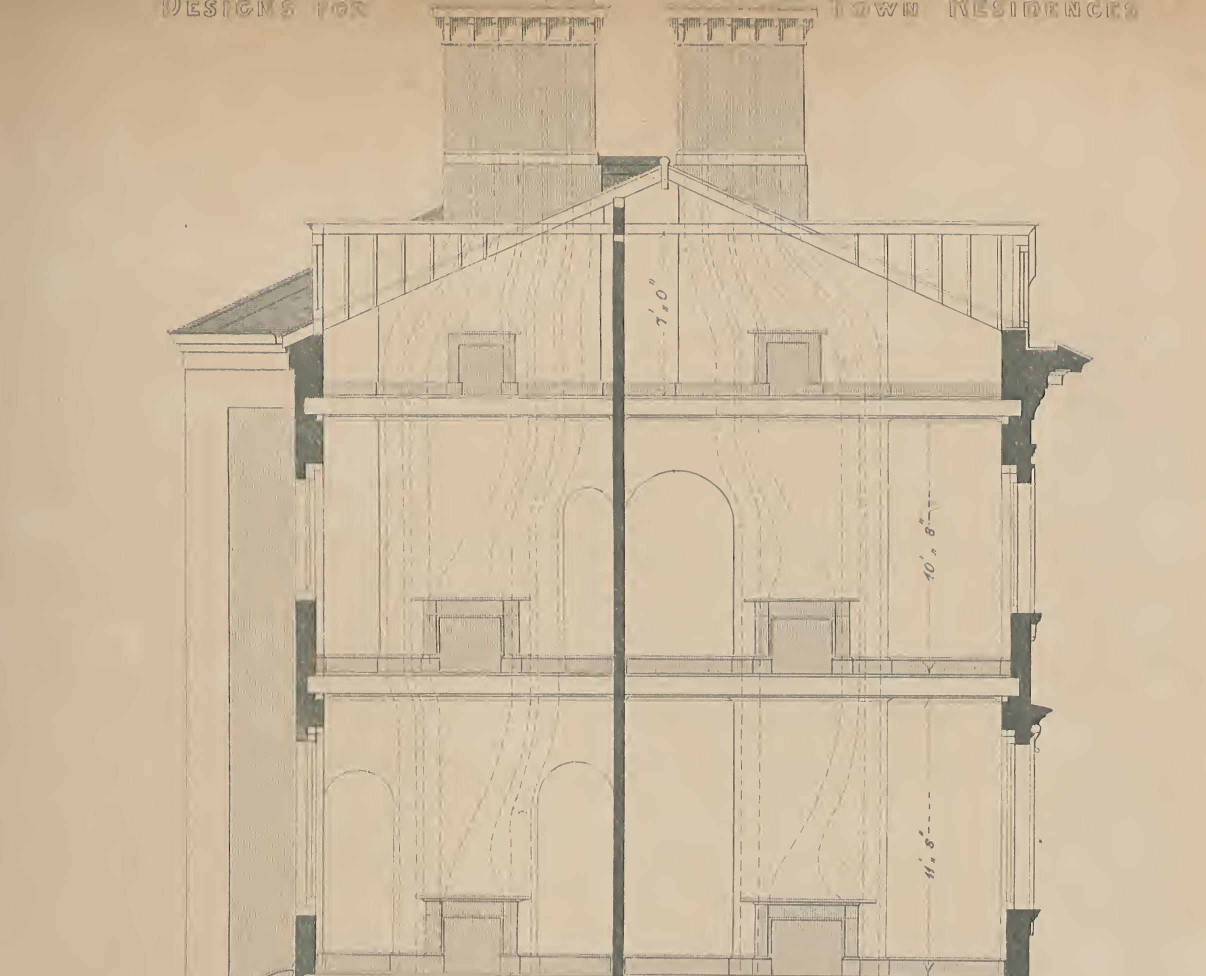


buck inv.

A. H. Payne

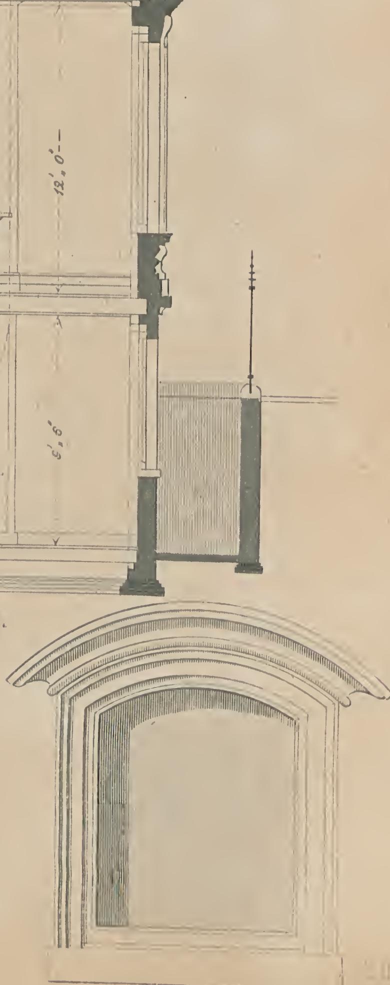
DESIGNS FOR TOWN RESIDENCES —

Plate 68



SECTION ON THE LINE A.B.

DETAILS OF DORMERS



SCALE TO SECTION

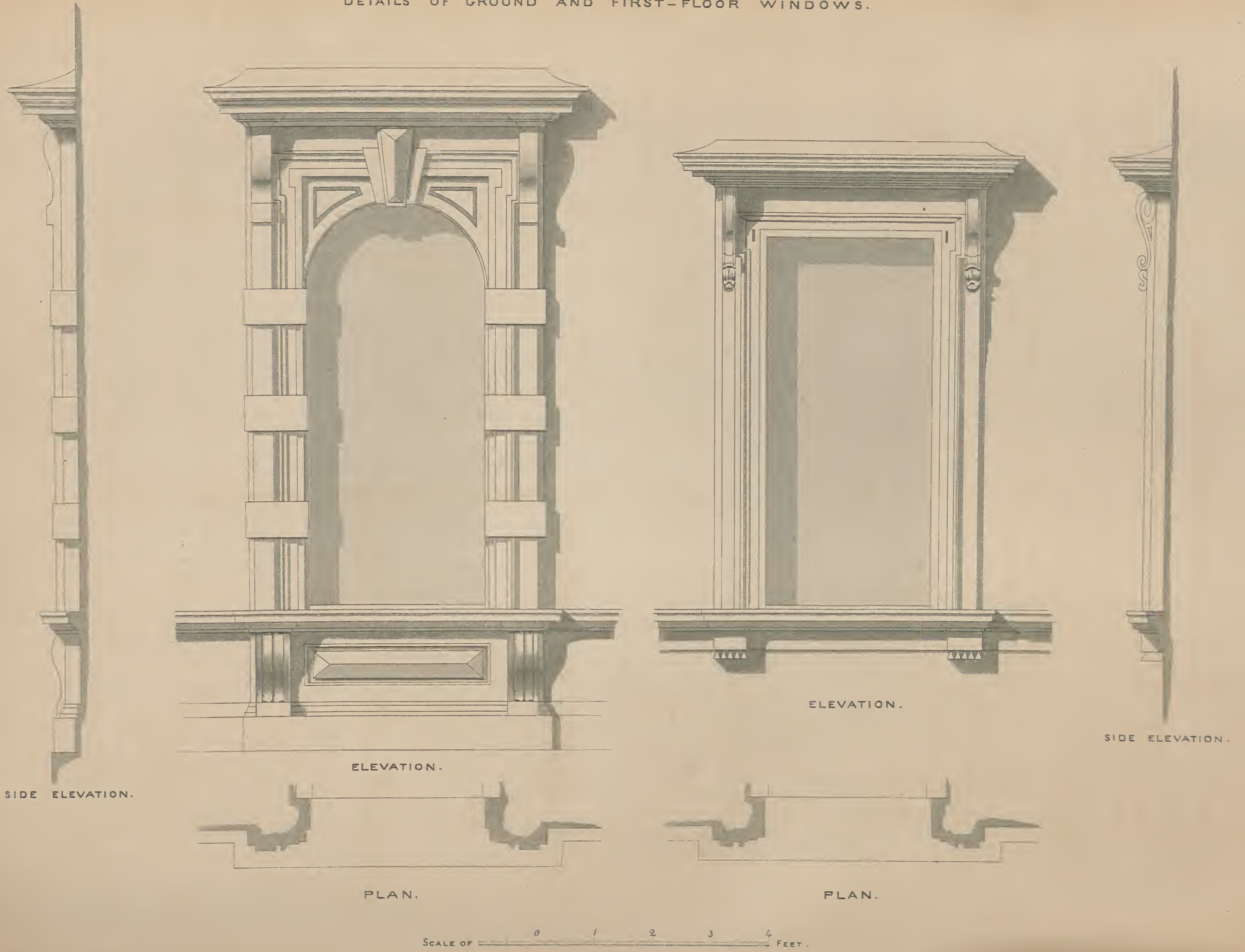
5 10 FEET

SCALE TO DETAILS.

0 1 2 FEET

...k inv.

DETAILS OF GROUND AND FIRST-FLOOR WINDOWS.



DESIGN FOR A GENTLEMAN'S RESIDENCE

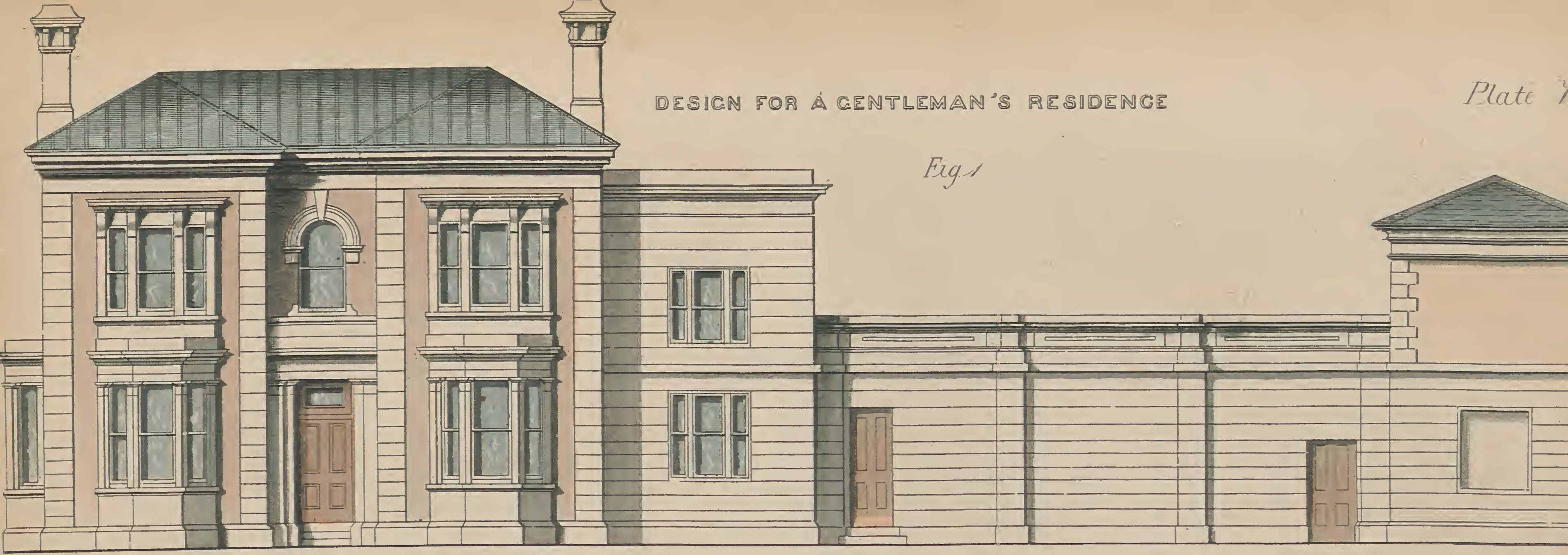


Fig. 1

GENERAL ELEVATION

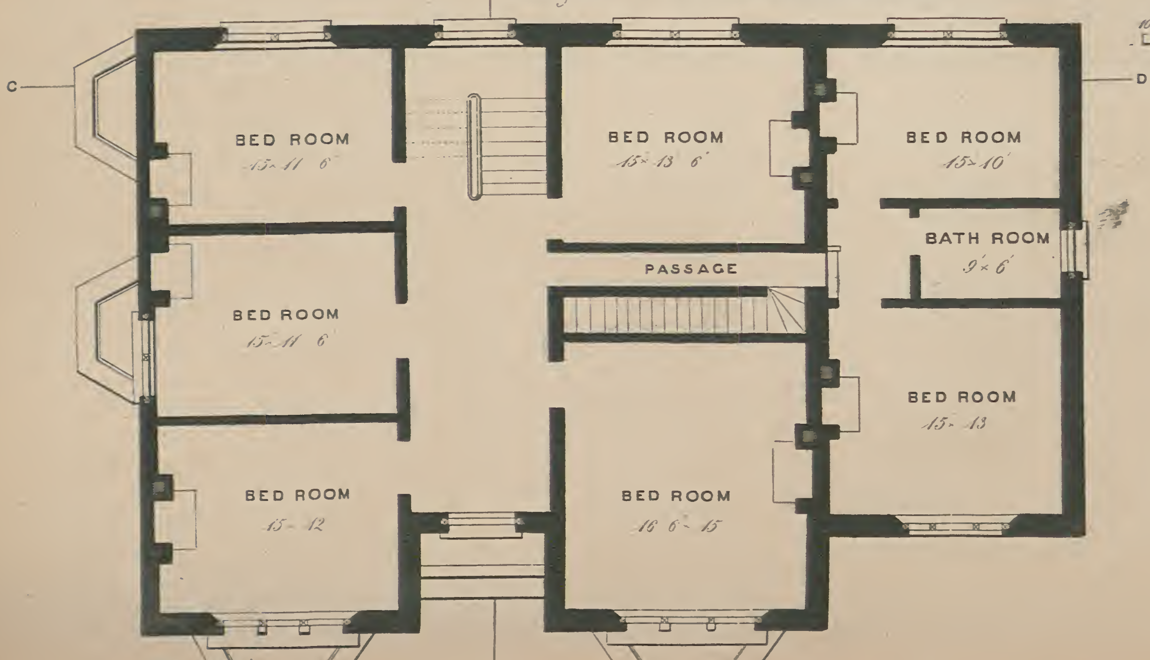


Fig. 2

10 9 8 7 6 5 4 3 2 1 0 10 20 30 FEET

SCALE OF FEET

Fig. 3

ELEVATION OF COACH HOUSE AND STABLE

Plate 72

GROUND PLAN TO PLATE 11

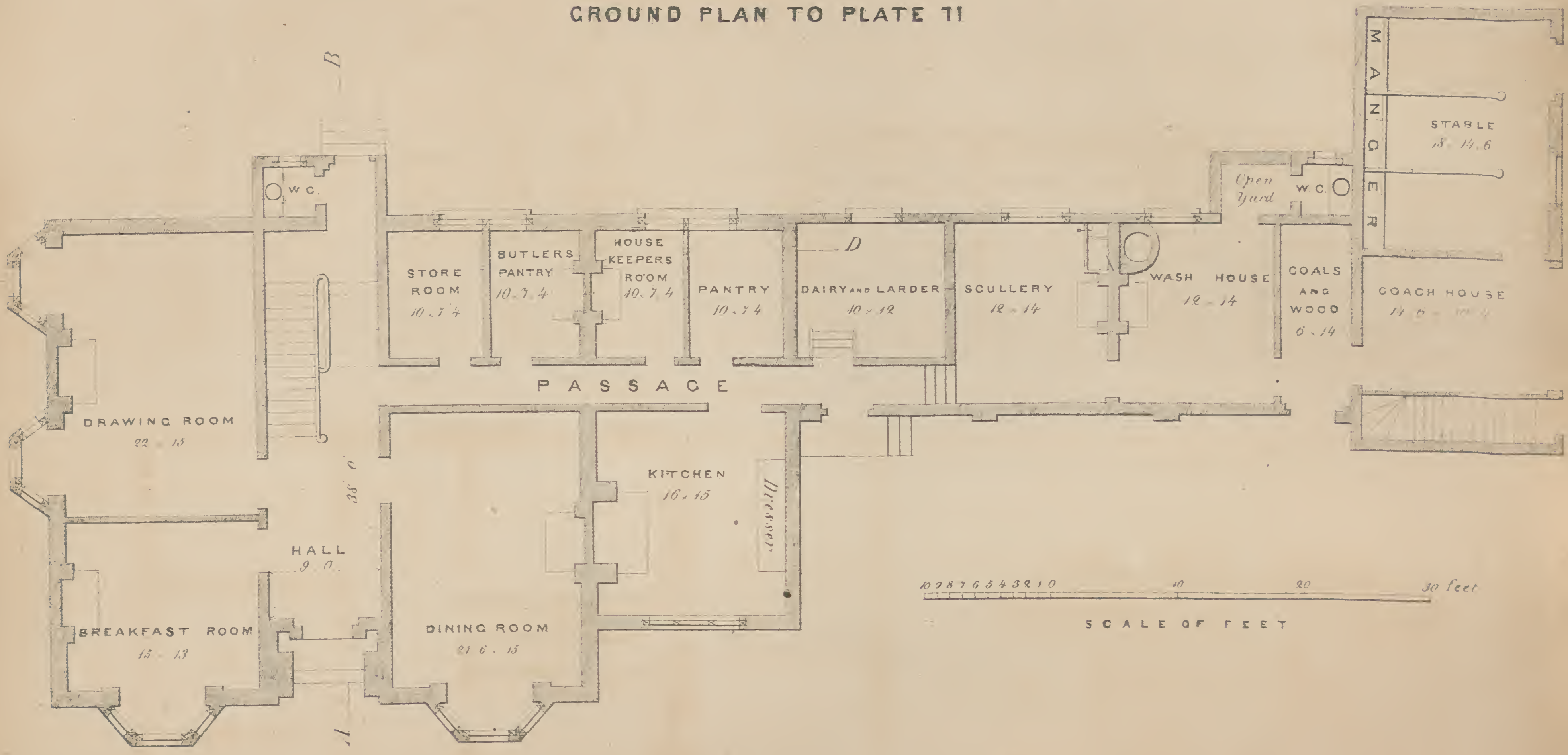
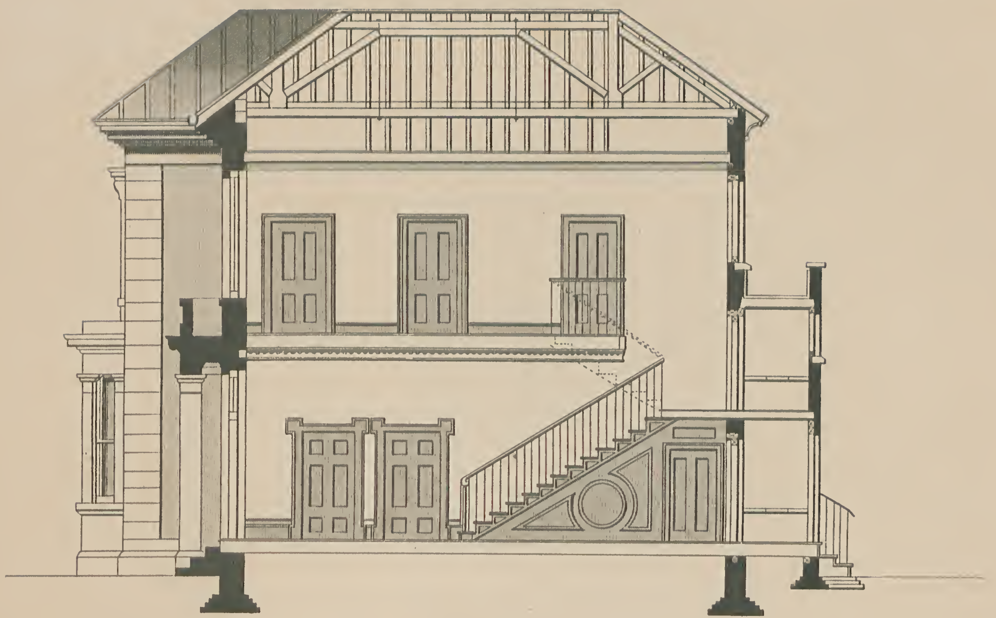


Fig. 1.



SECTION AT A. B.

Fig. 2.

SECTION AT C. D.

Designs for Shop Fronts.

No. 1

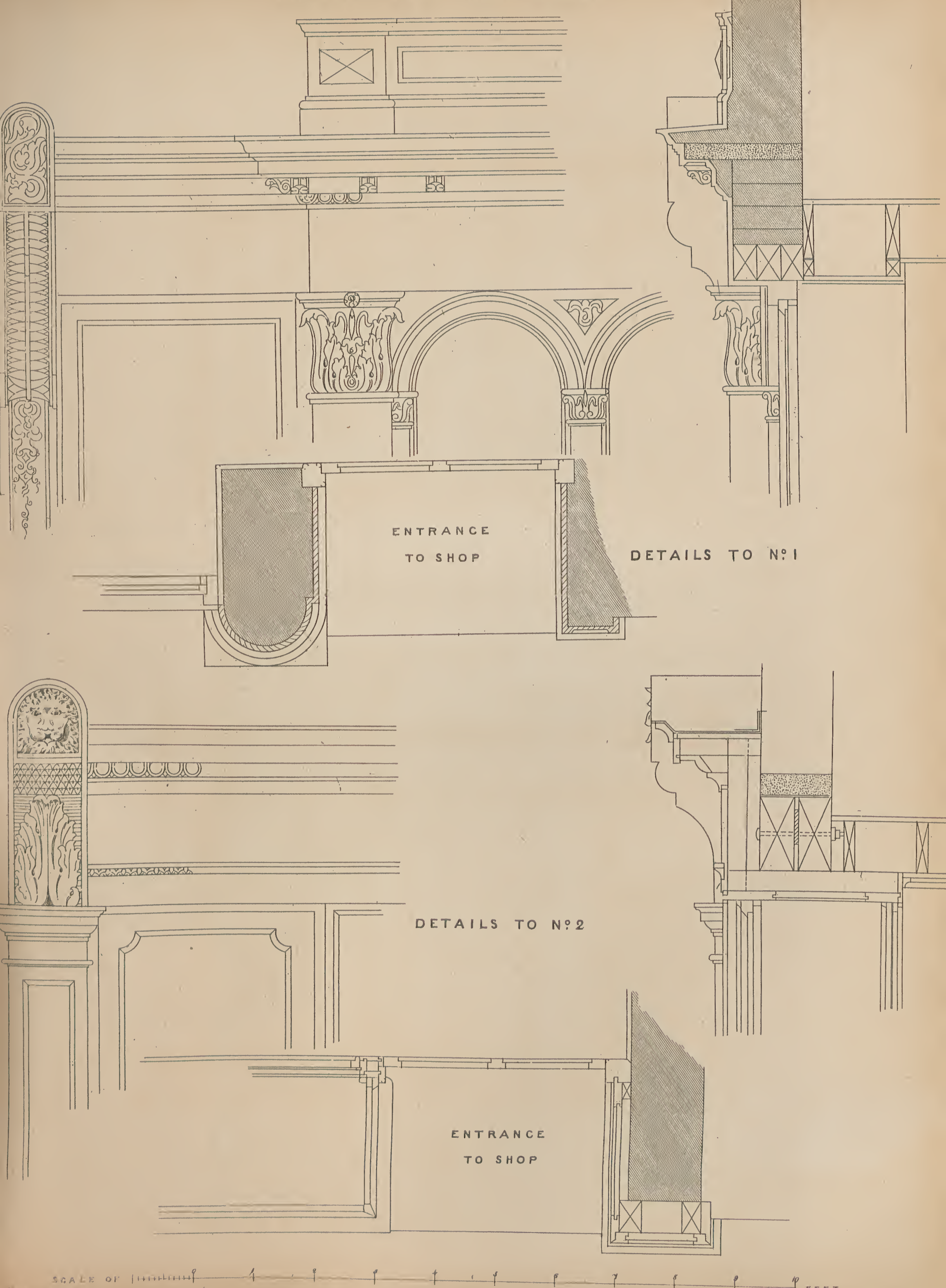
No. 2

SCALE OF 10 5 0 10 FEET

arbuck des.

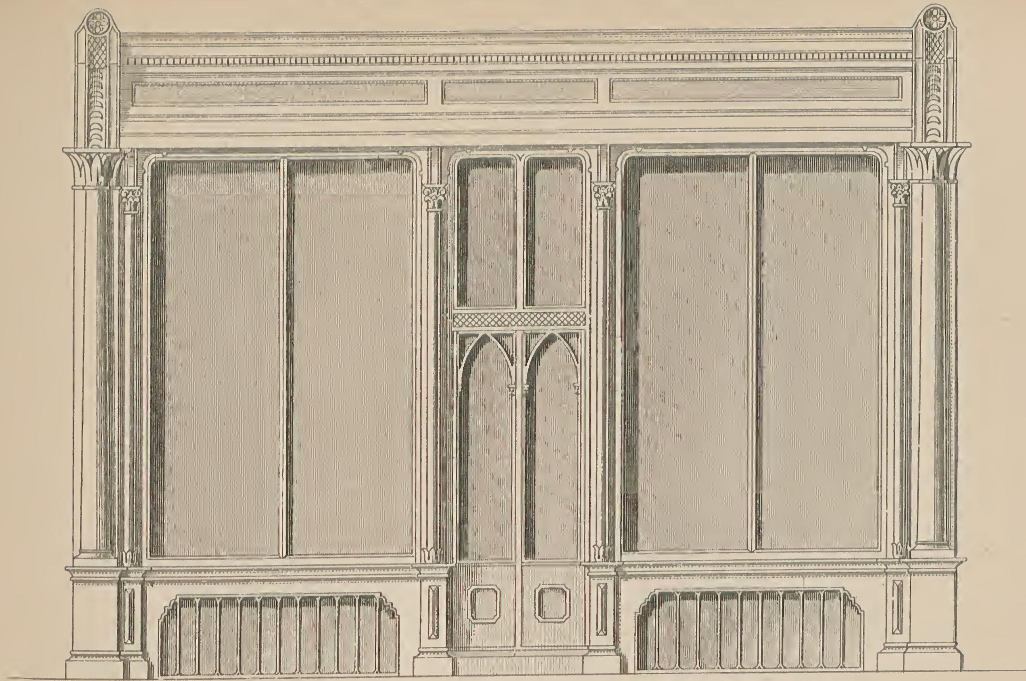
A H Payne

Designs-for-Shop-Fronts.

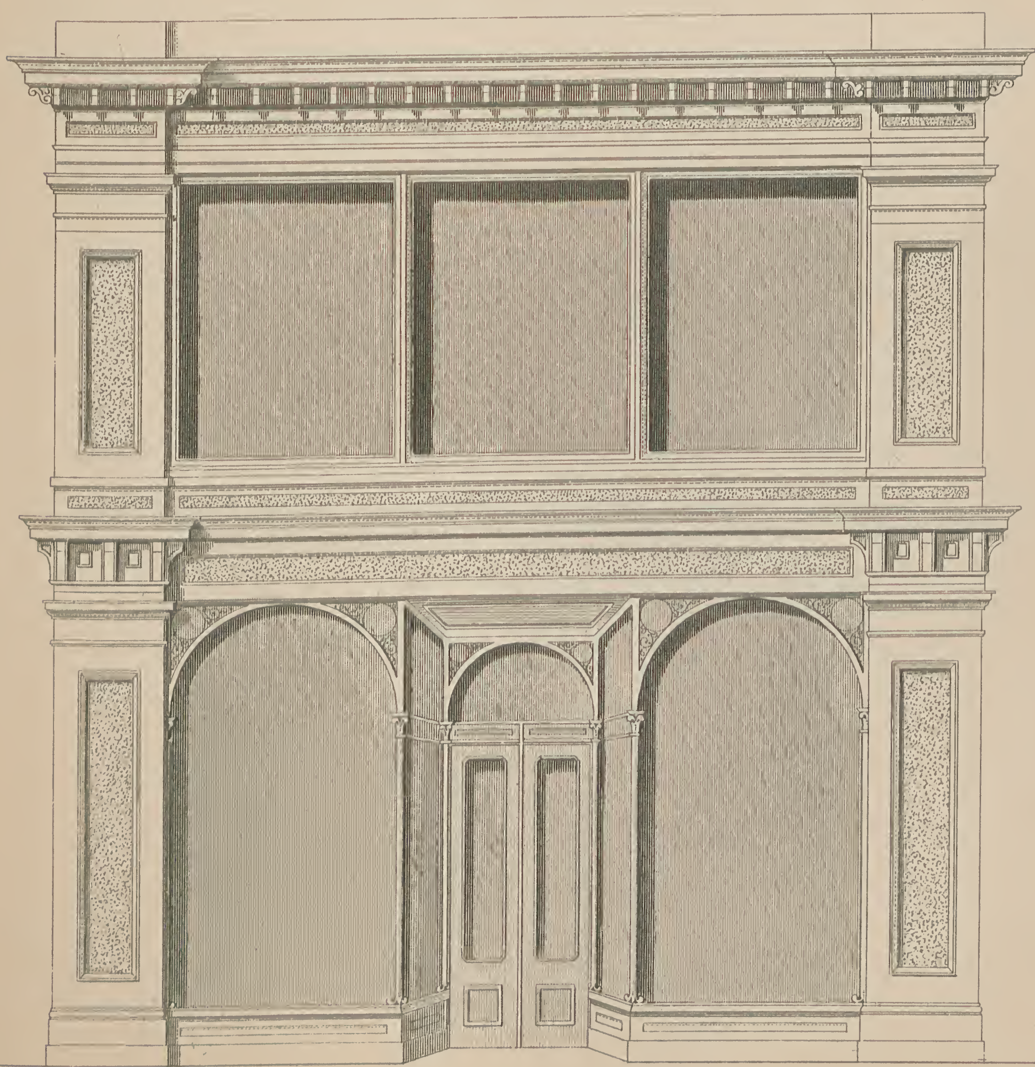


Tarbuck inv.

DESIGNS-FOR-SHOP FRONTS-



No. 4.

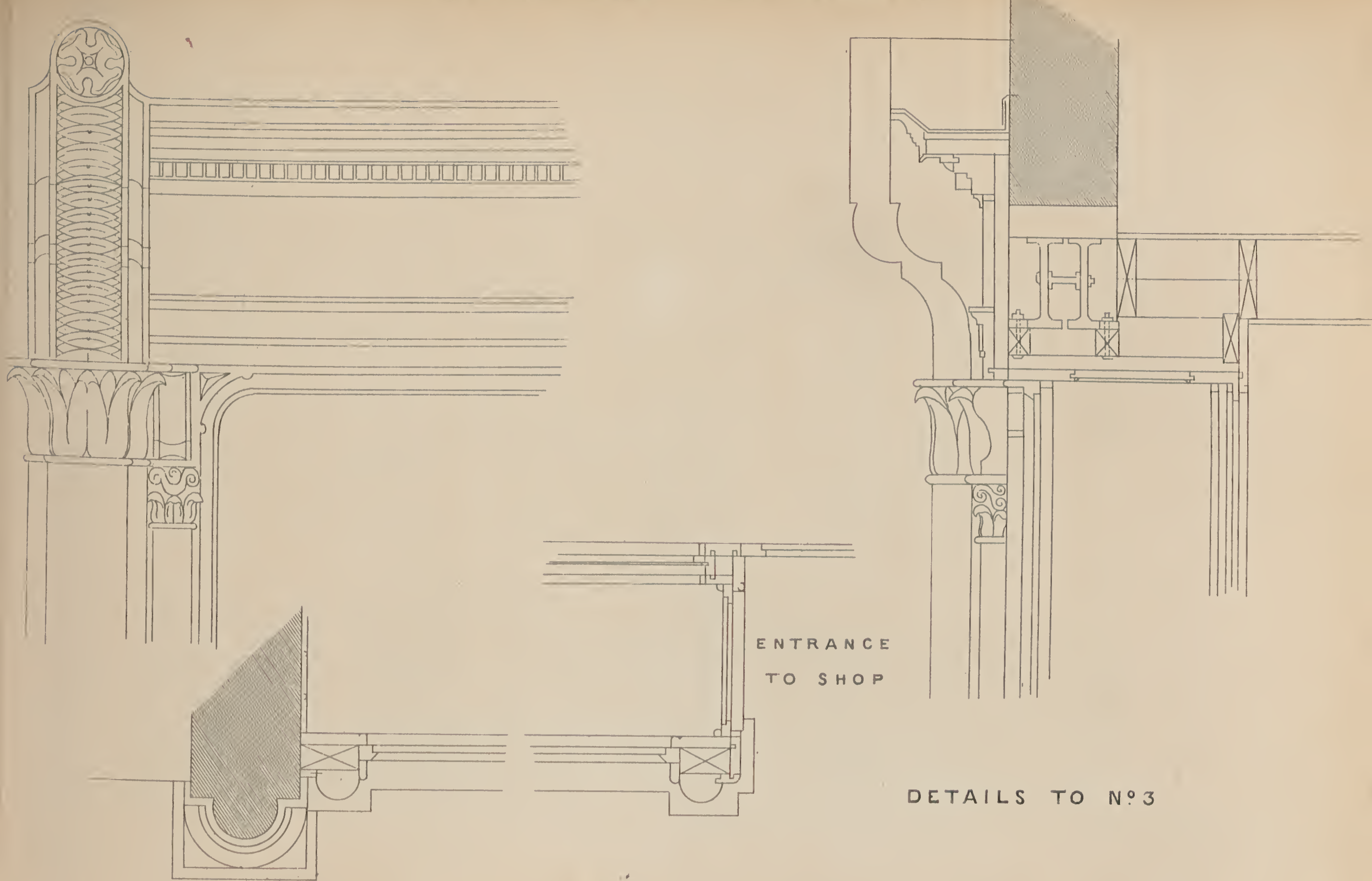


Buck inv

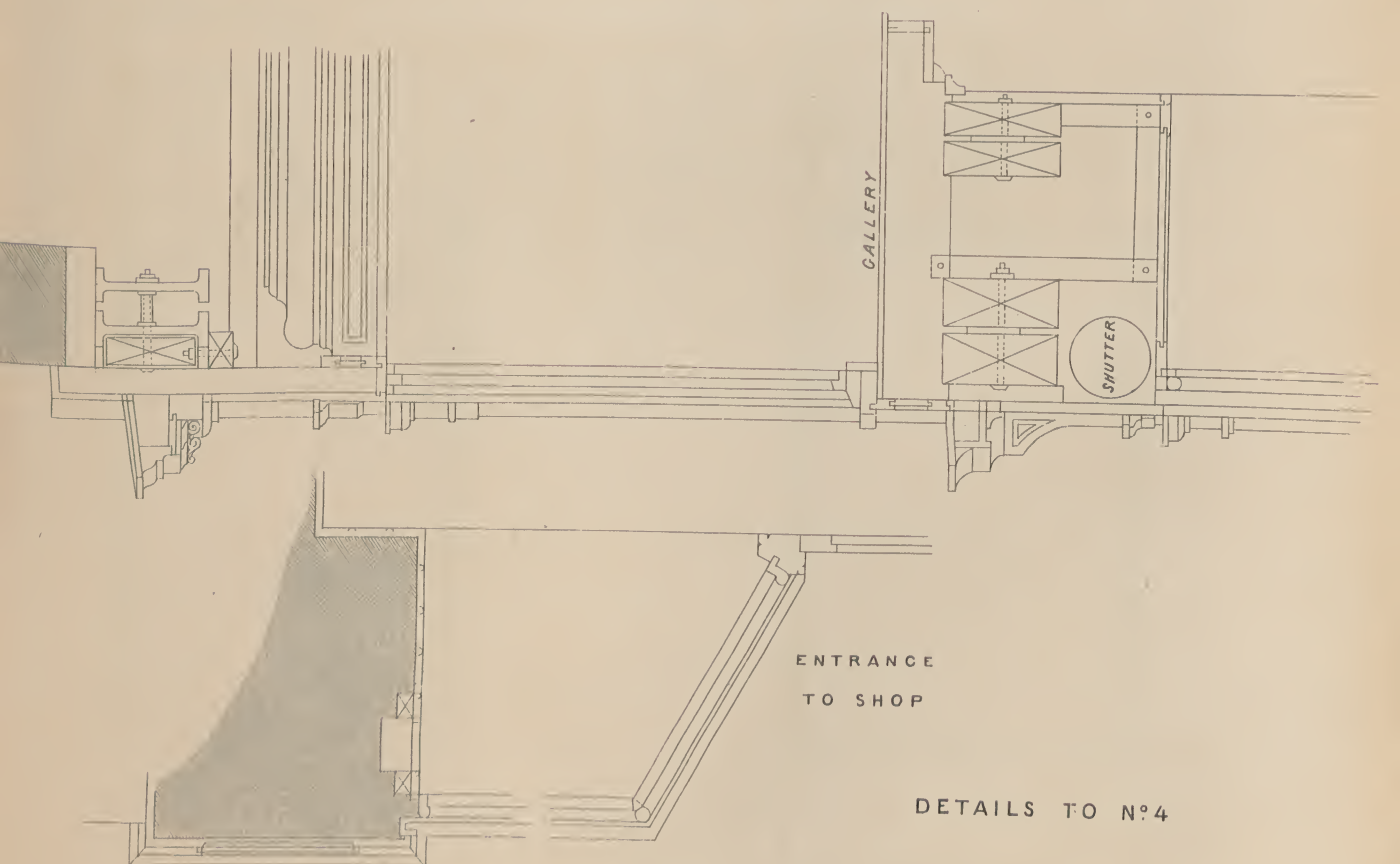
A.H. Payne sc

No. 3

SCALE OF 10 5 0 10 FEET



DETAILS TO Nº 3

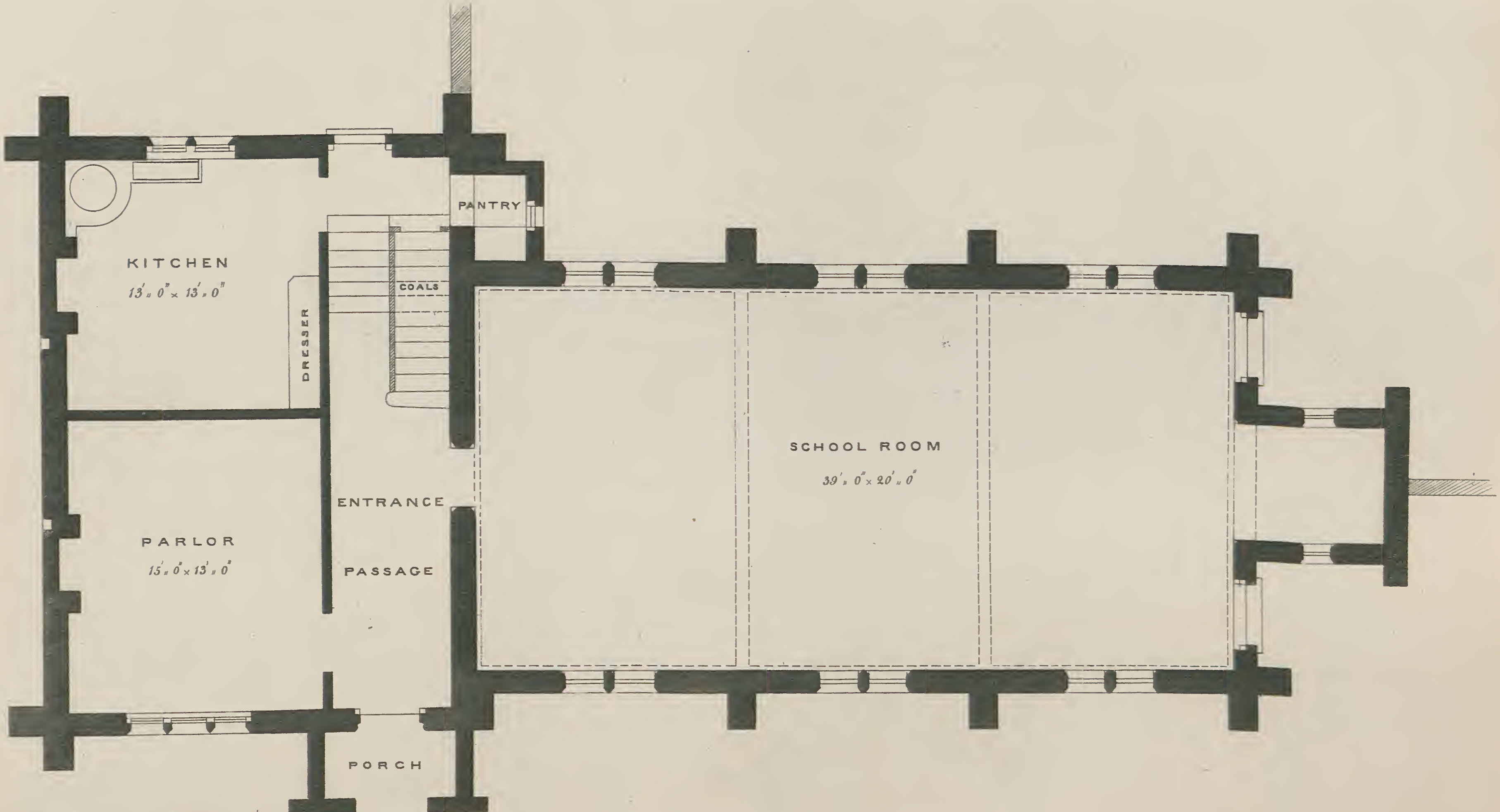


DETAILS TO Nº 4

SCALE OF 0 1 2 3 4 5 6 7 8 9 10 FEET

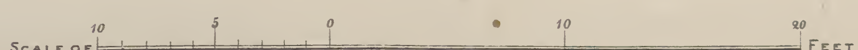
...arbuck inv. ... Page

PUBLIC SCHOOL AND RESIDENCE.



THREE BED ROOMS & W. C'.. ON CHAMBER FLOOR

PLAN OF GROUND LEVEL.



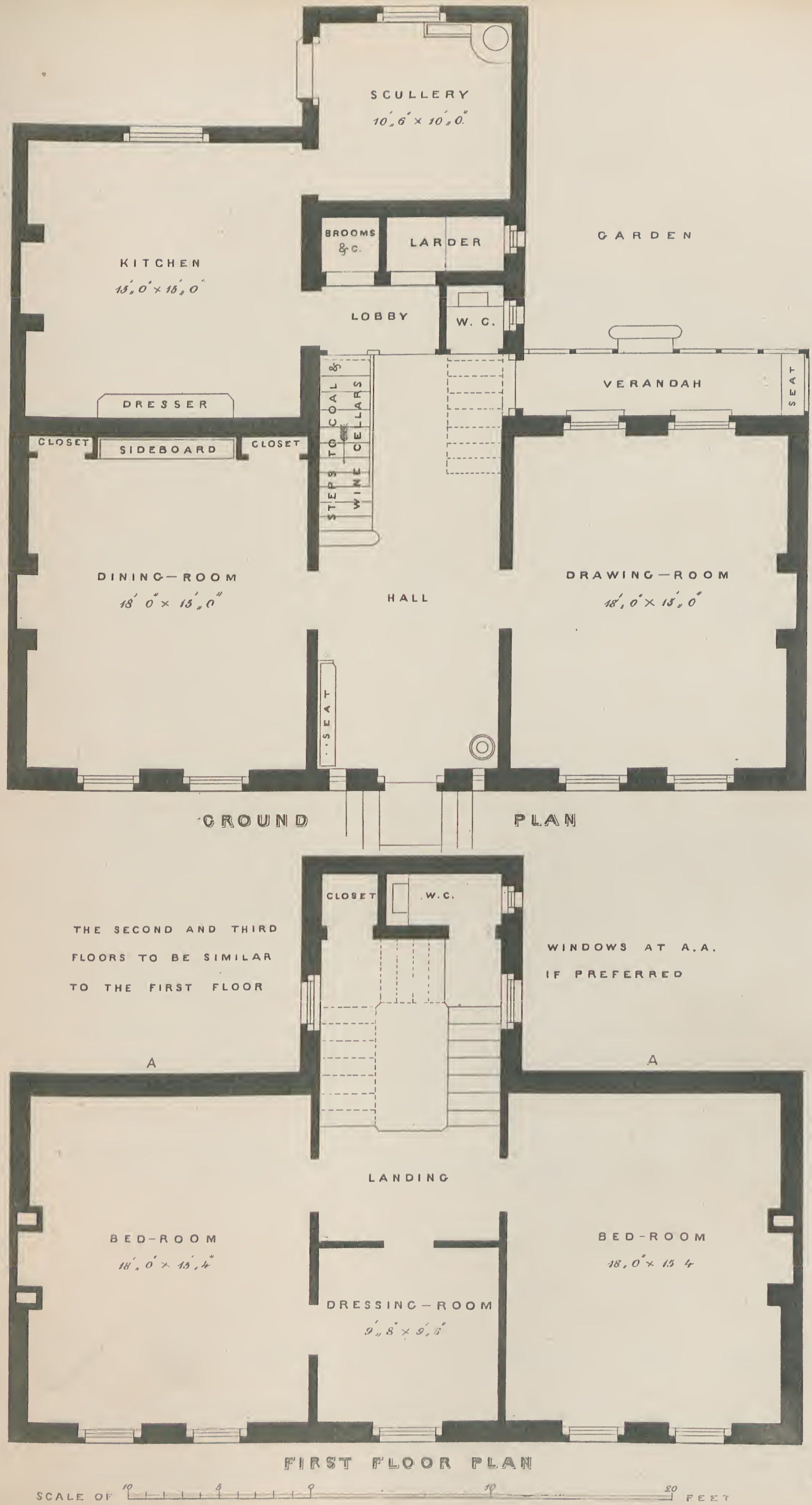
T Smith

A H Payne sc

Plate 80.

PUBLIC SCHOOL AND RESIDENCE.

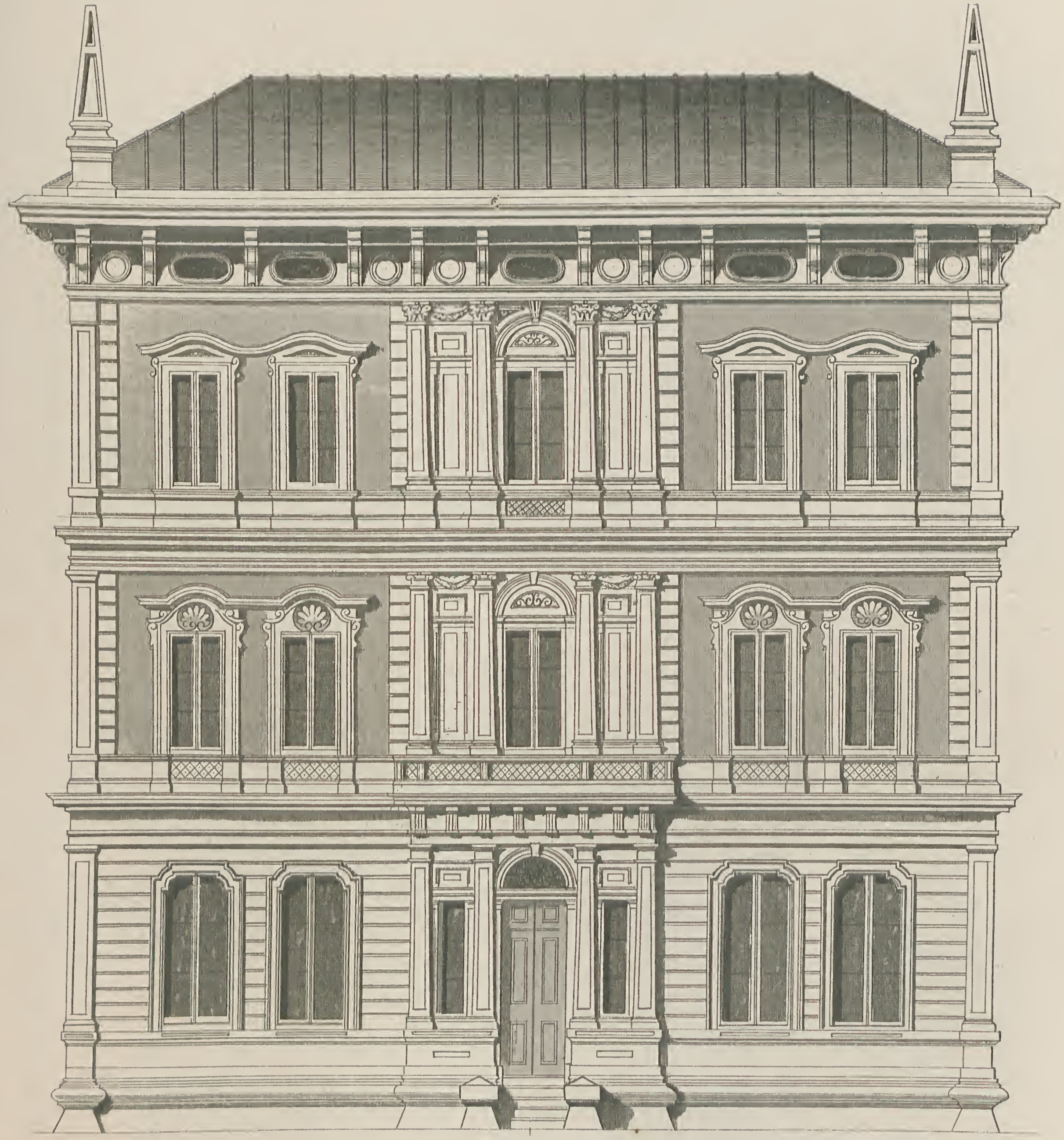
E. L. Tarbuck inv. A. F. Payne sc.


SCULLERY
10' 6" × 10' 0"
KITCHEN
15' 0" × 15' 0"
BROOMS &c.
LARDER
GARDEN
LOBBY
W. C.
VERANDAH
SEAT
DRESSER
STEPS TO COAL & WINE CELLARS
CLOSET
SIDEBOARD
CLOSET
DINING-ROOM
18' 0" × 15' 0"
HALL
DRAWING-ROOM
18' 0" × 15' 0"
SEAT
GROUND PLAN
CLOSET
W.C.
THE SECOND AND THIRD FLOORS TO BE SIMILAR TO THE FIRST FLOOR
WINDOWS AT A.A. IF PREFERRED
A
A
LANDING
BED-ROOM
18' 0" × 15' 4"
BED-ROOM
18' 0" × 15 4
DRESSING-ROOM
9' 8" × 9' 6"
FIRST FLOOR PLAN
SCALE OF 10 5 0 10 20 FEET

A. H. Payne sc.

ILLUSTRATIONS OF STREET ARCHITECTURE.

DESIGN FOR A TOWN HOUSE.



ELEVATION

HORIZONTAL SECTION THROUGH GROUND FLOOR WINDOWS.

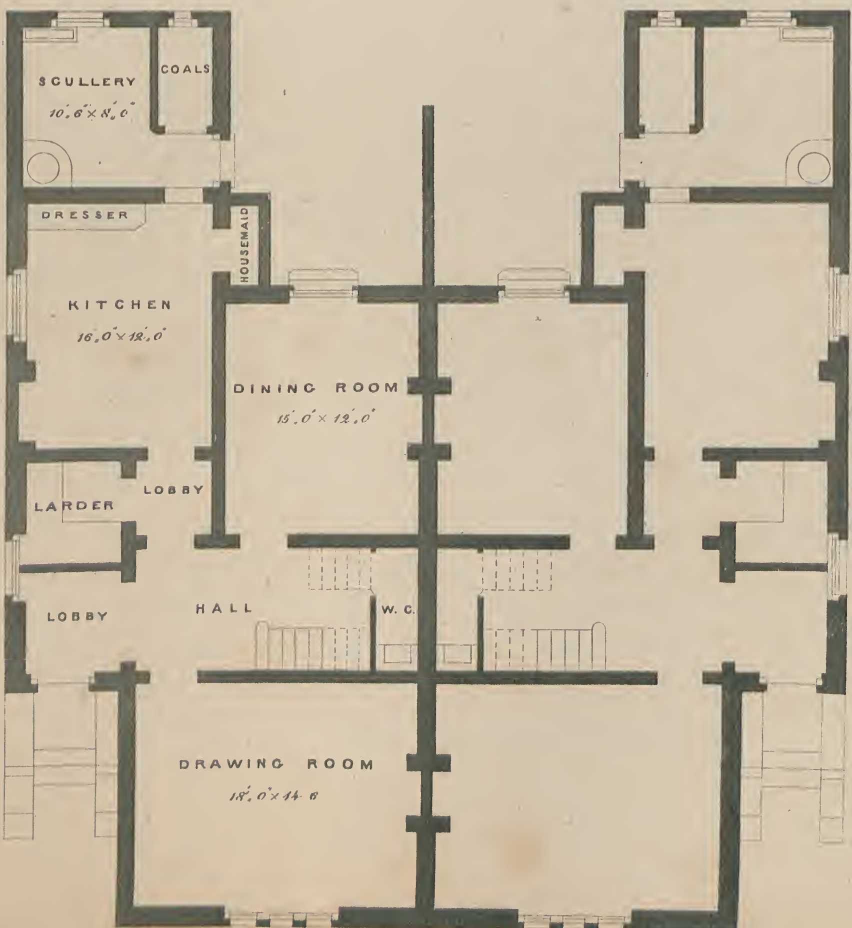
SCALE OF 10 5 0 10 20 FEET.

E.L.Tarbuck inv

A.H.Payne sc

DETAILS OF FIRST AND SECOND FLOOR WINDOWS.

FRONT ELEVATION



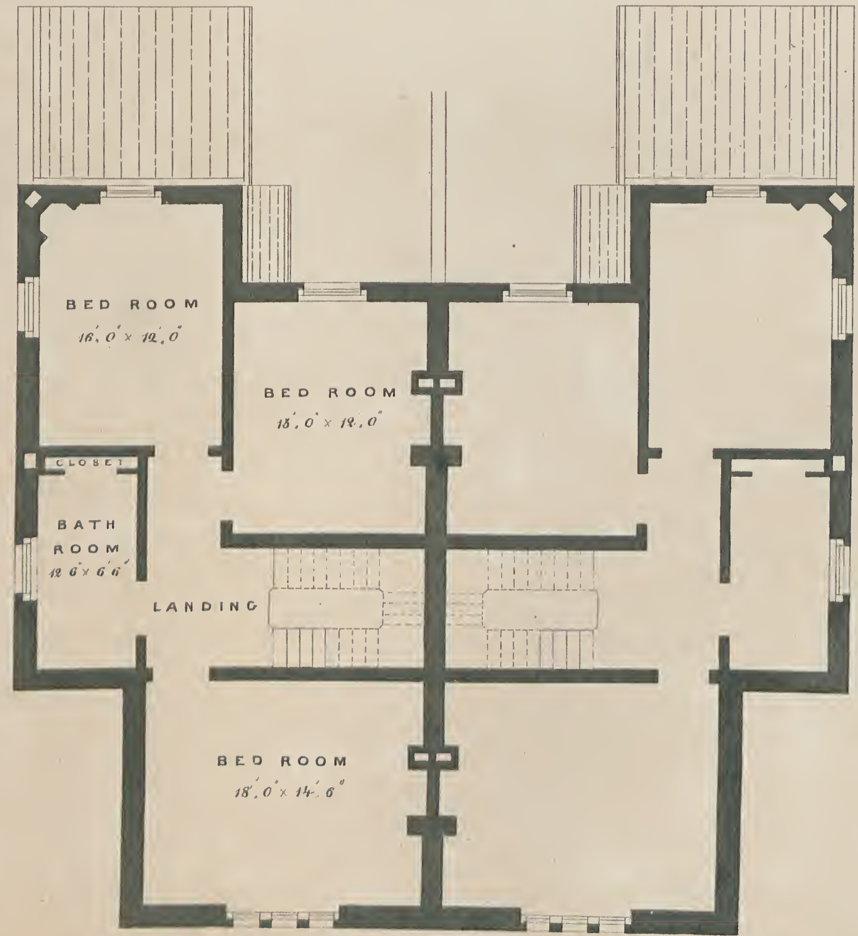
PLAN OF GROUND FLOOR

SCALE OF 10 5 0 10 20 FEET

A. H. Payne sc.

Design for Semi-Detached Family Residences.

SIDE ELEVATION

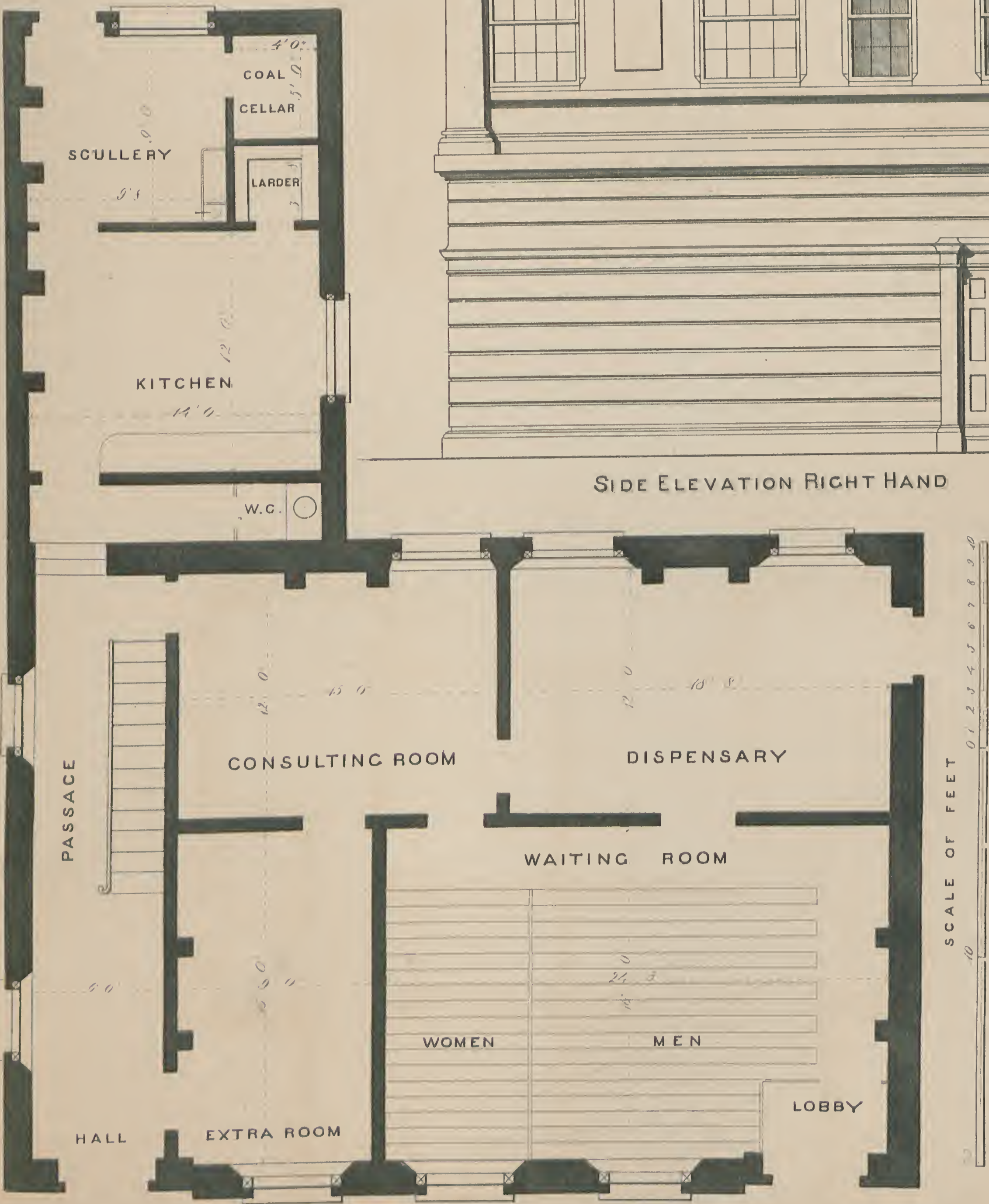


PLAN OF FIRST FLOOR

Barbuck inv. SCALE OF 10 5 0 10 20 FEET A. H. Payne sc.

PUBLIC DISPENSARY.

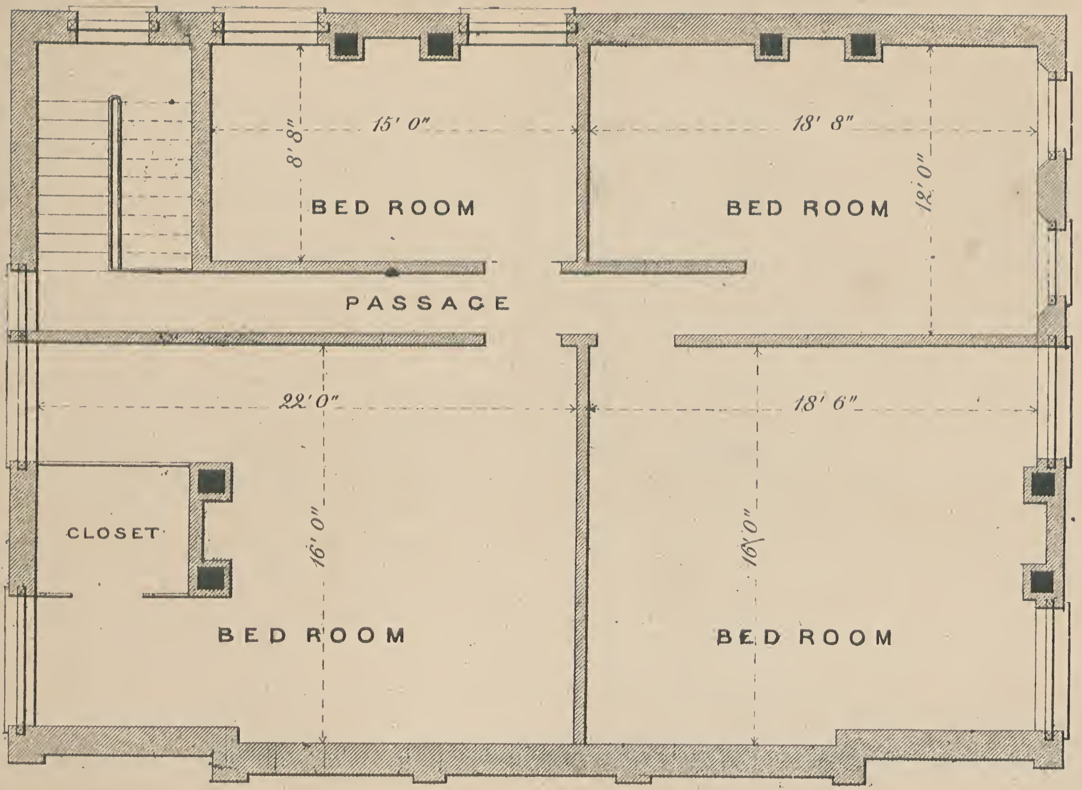
SIDE ELEVATION RIGHT HAND



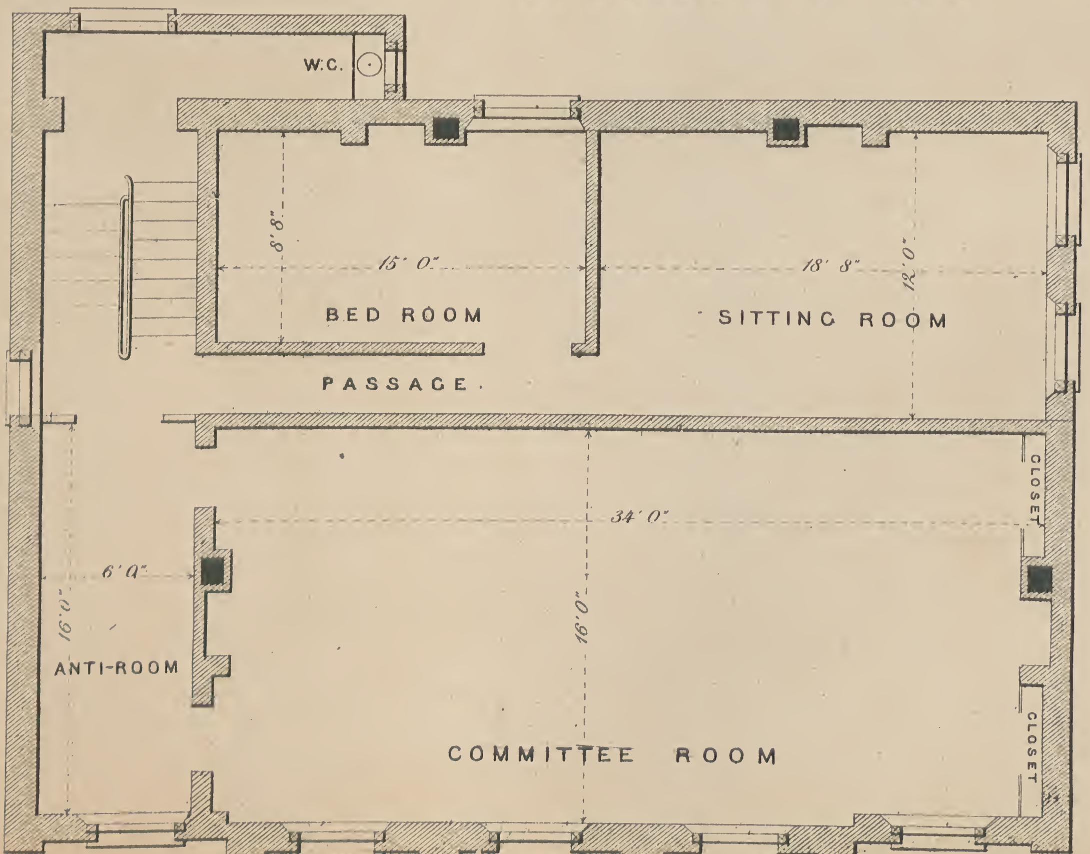
PLAN OF GROUND FLOOR

A. H. P...

PLAN OF SECOND FLOOR



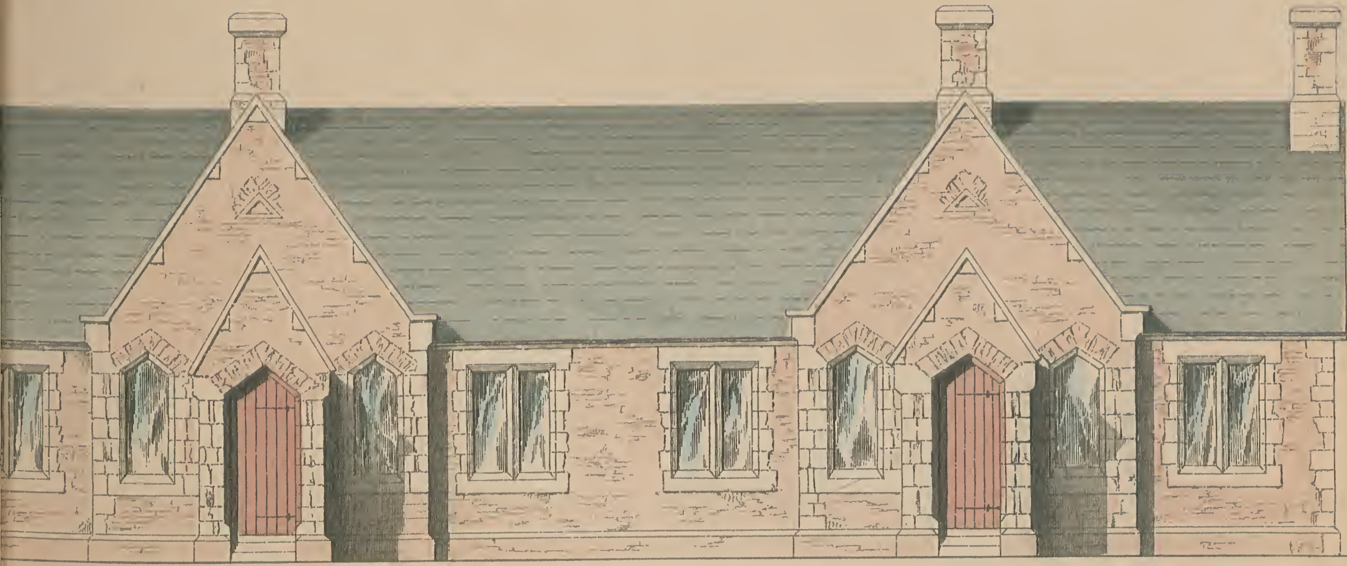
SIDE ELEVATION LEFT HAND



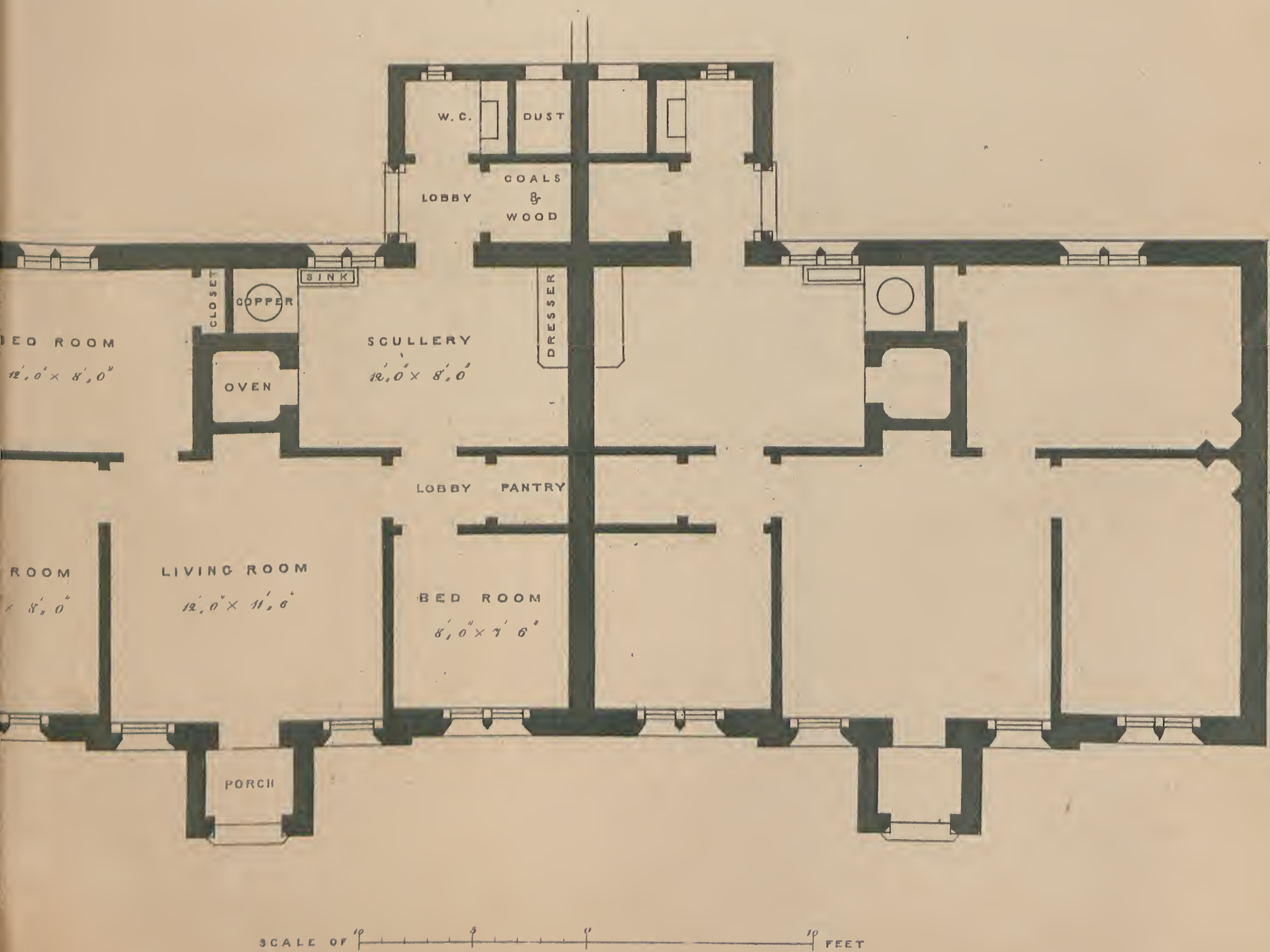
PLAN OF FIRST FLOOR

Design for a Pair of Model Cottages

FOR LABOURERS, MECHANICS &c.



FRONT ELEVATION

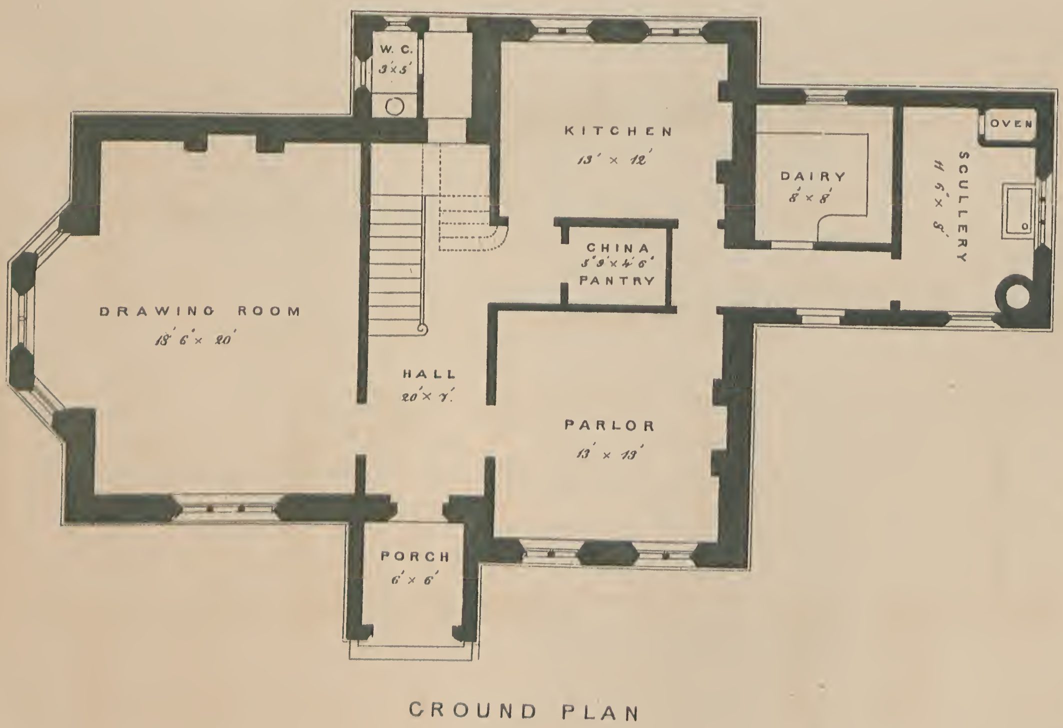


lk inv

A H Payne sc

A Country House.

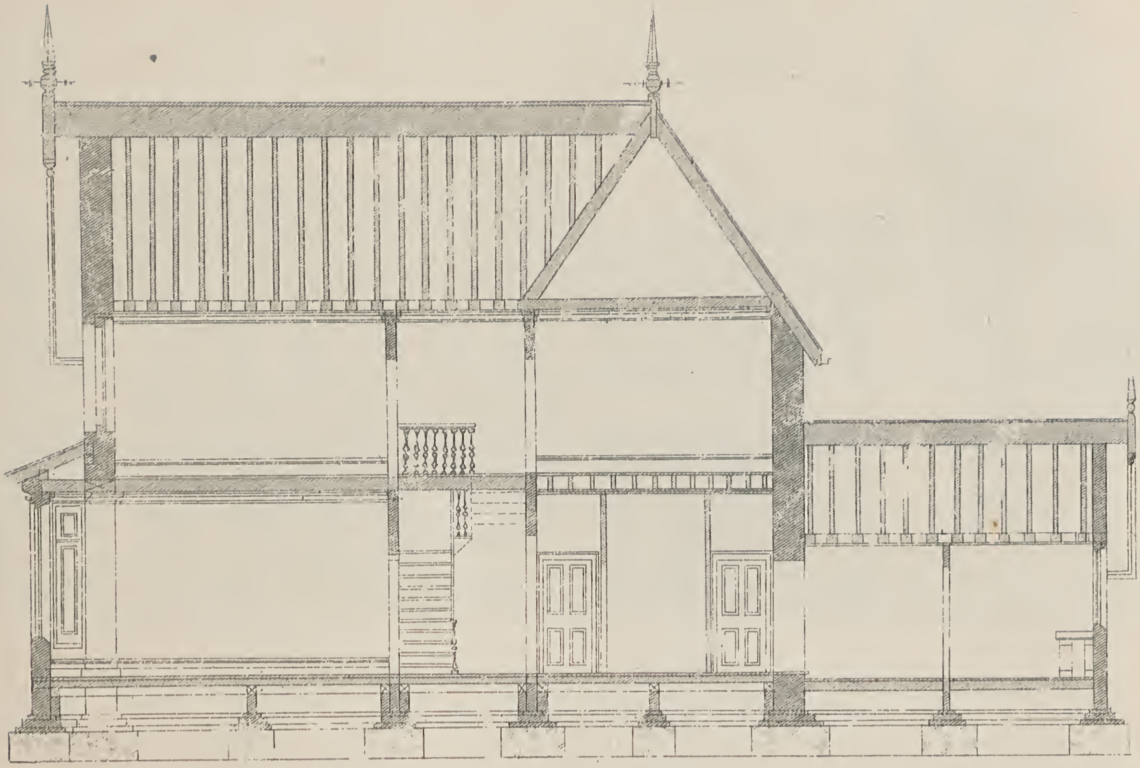
ELEVATION



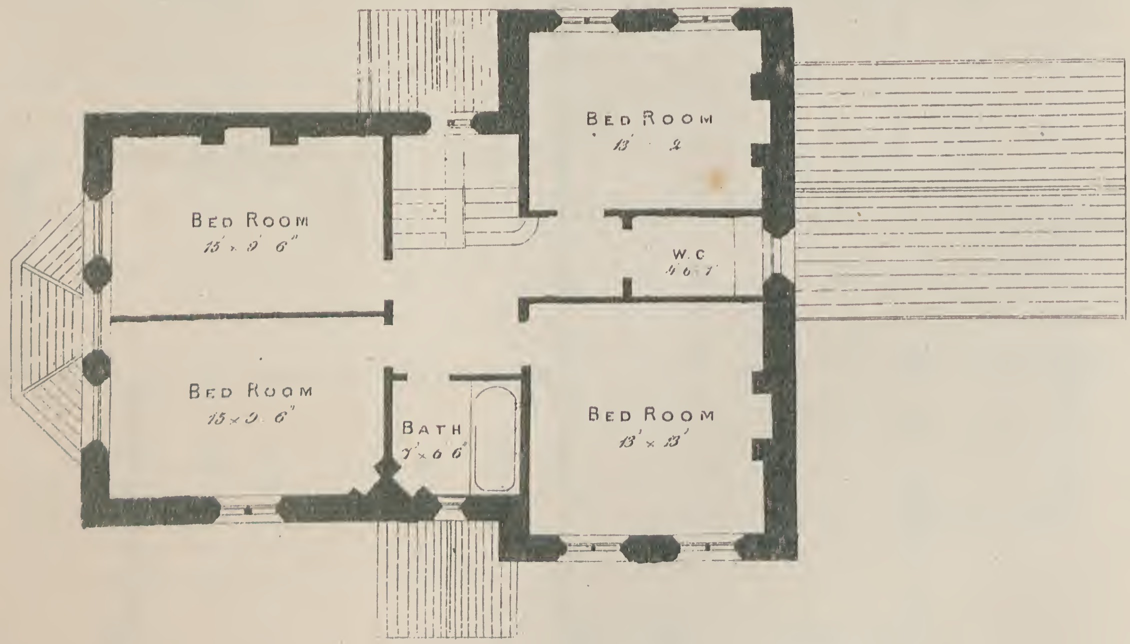
GROUND PLAN

SCALE OF 10 9 8 7 6 5 4 3 2 1 0 10 20 30 FEET

A COUNTRY HOUSE

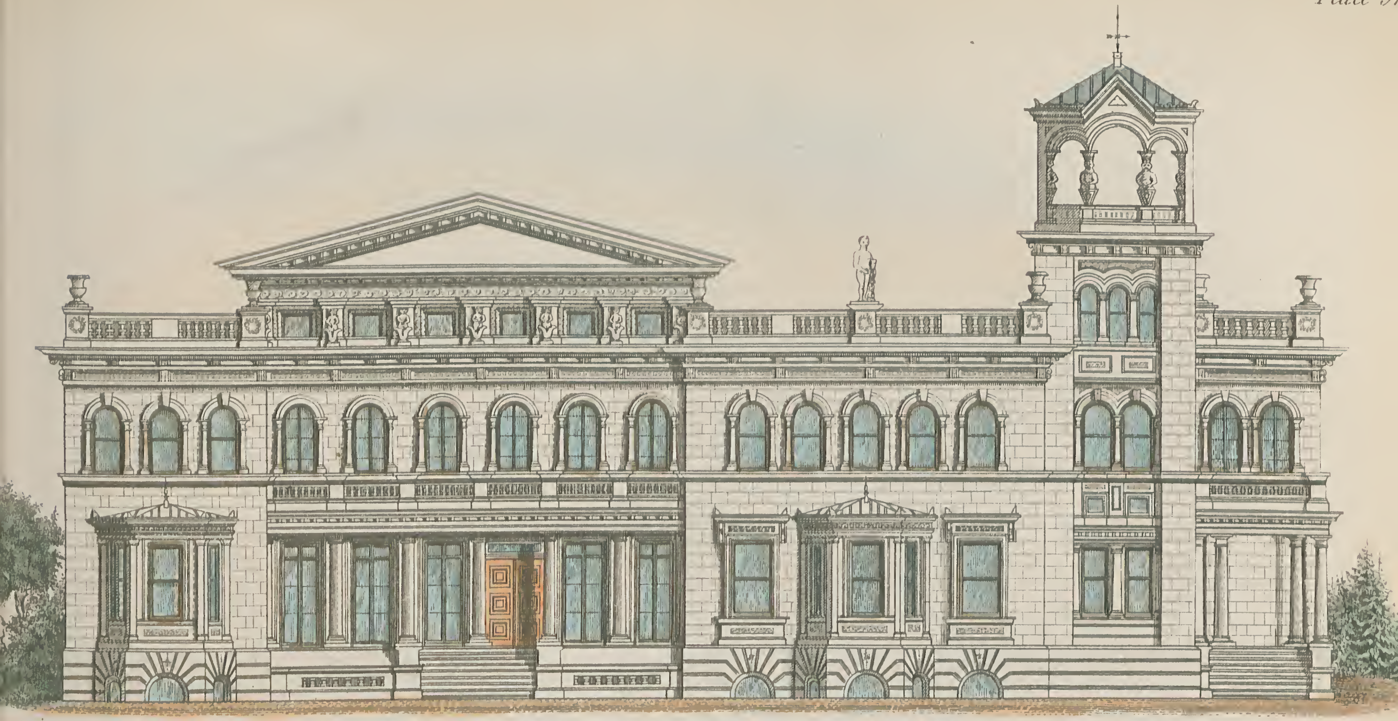


LONGITUDINAL SECTION

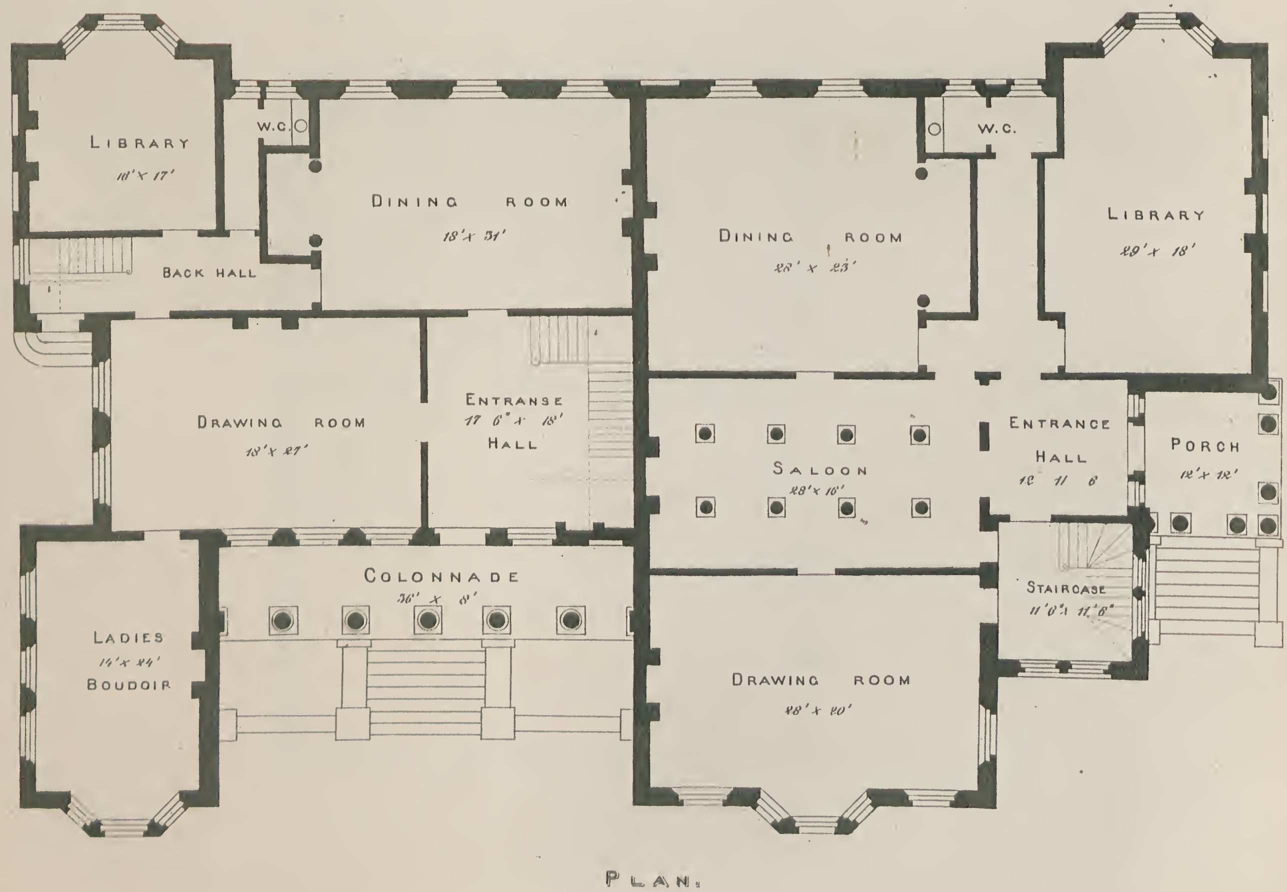


CHAMBER PLAN

SCALE OF FEET



ELEVATION.

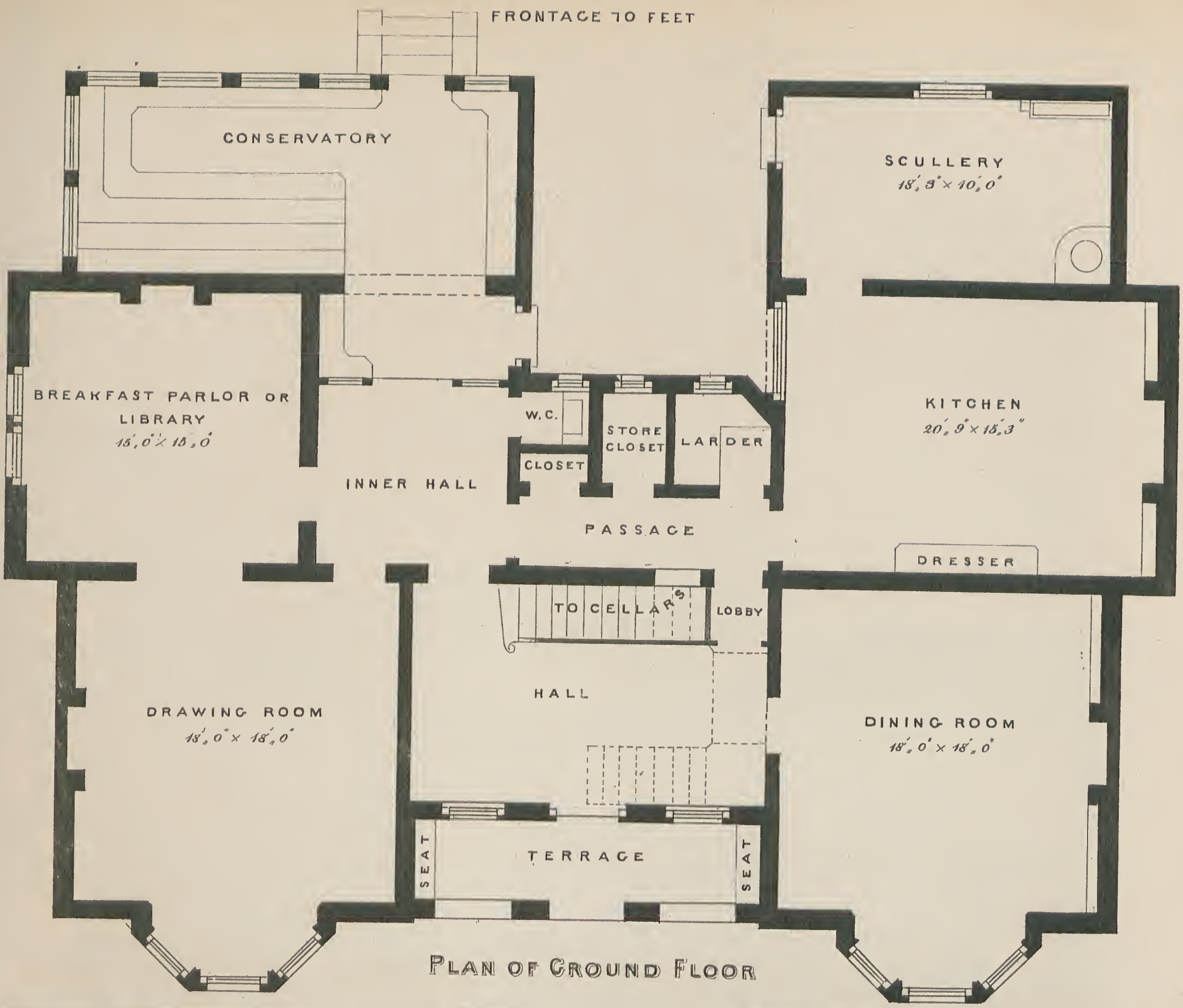


PLAN.

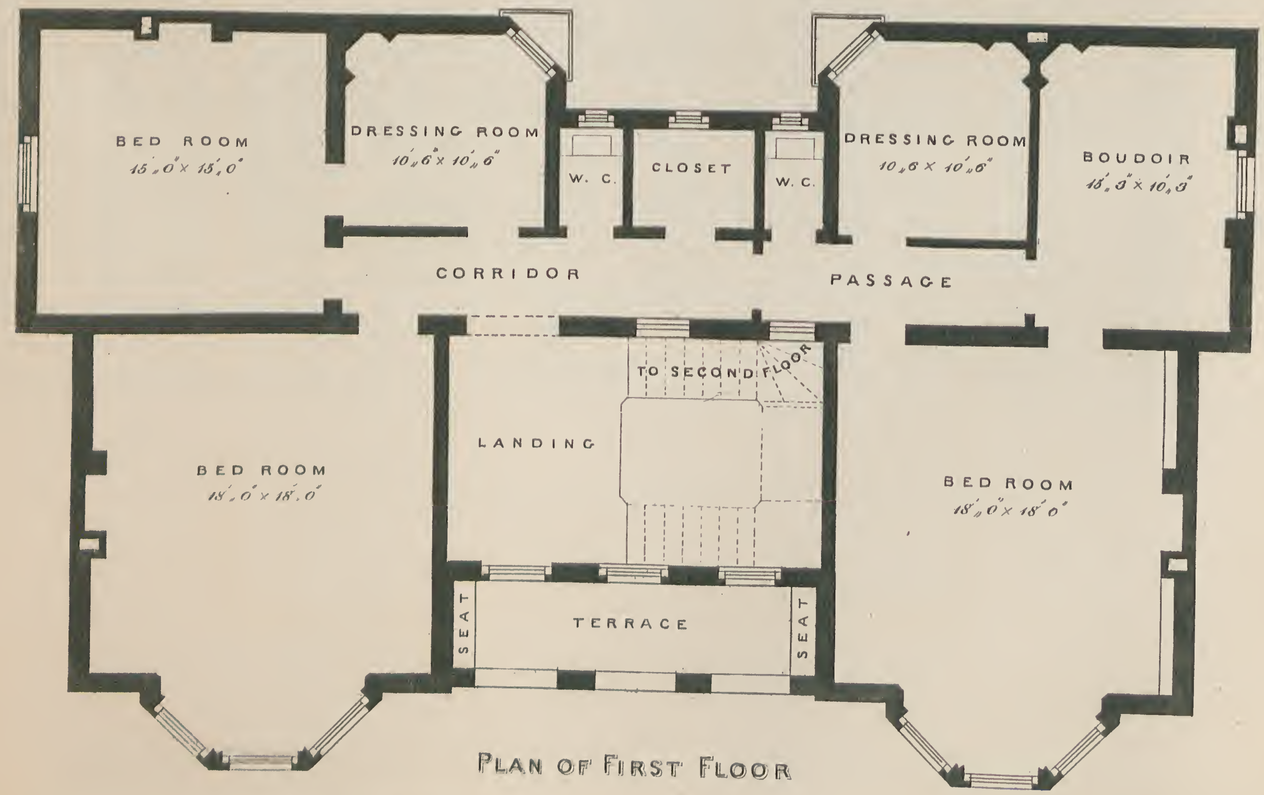
10 9 8 7 6 5 4 3 2 1 0 10 20 30 40 50

SCALE OF FEET.

S. Brookes A. H. Payne sc.



Plan of Ground Floor



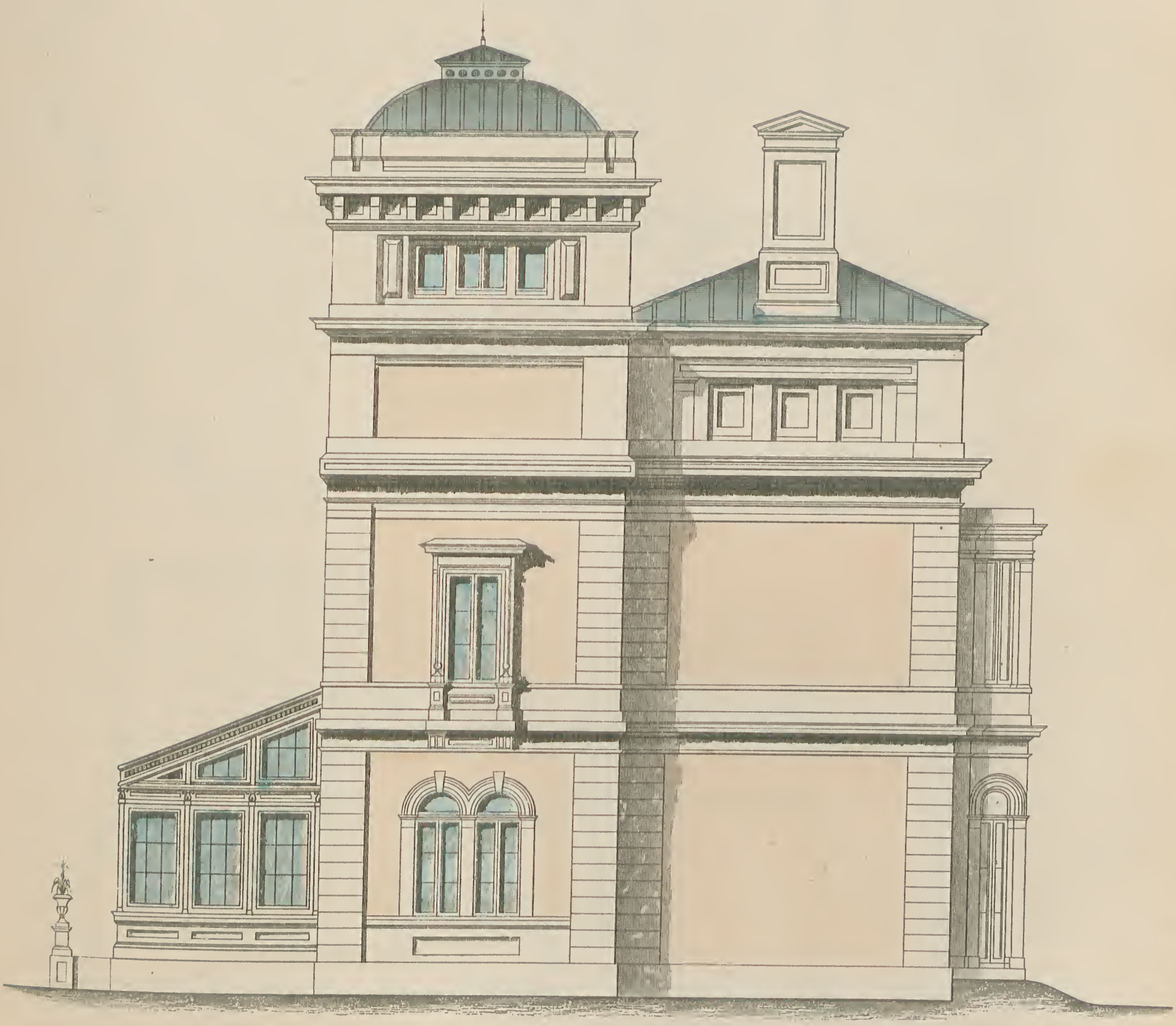
Plan of First Floor

rbuck inv. A.H.Payne sc

SCALE OF 10 5 0 10 20 FEET

DESIGN FOR AN ITALIAN VILLA

ADAPTED FOR A FRONTAGE OF 70 FEET.

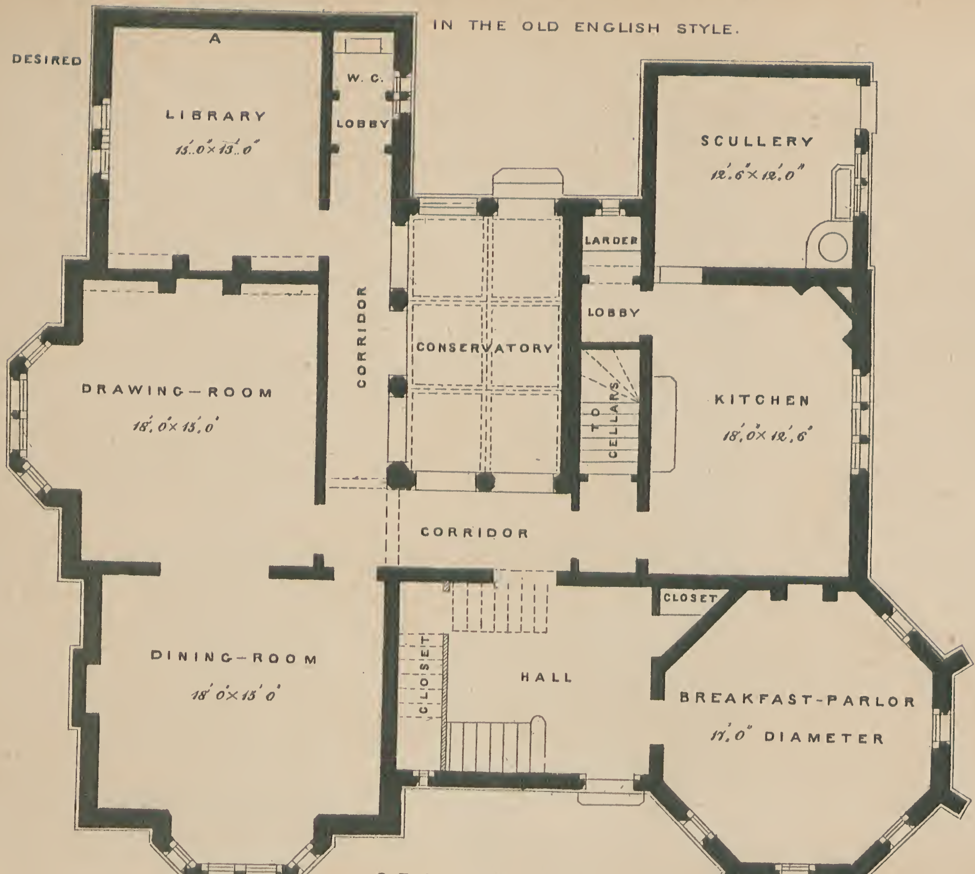


SIDE ELEVATION.

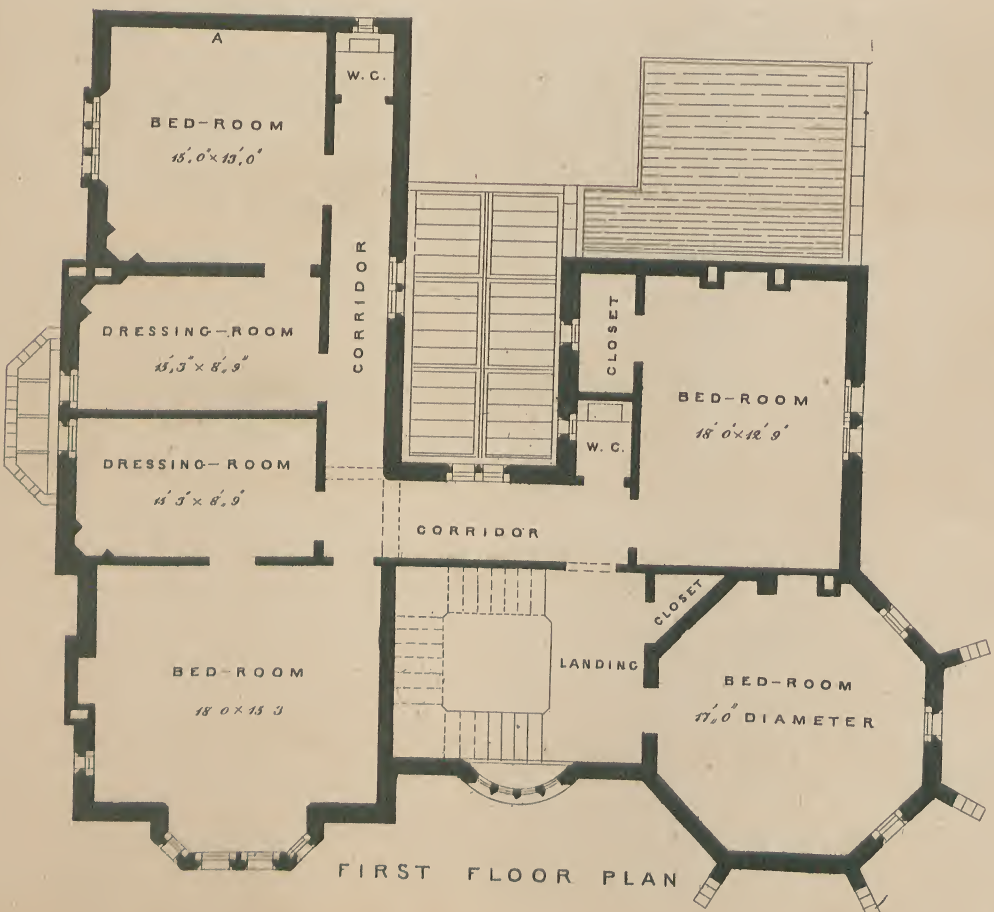
E.L. Tarbuck inv

A. H. Payne sc

DESIGN FOR A MANSION IN THE OLD ENGLISH STYLE.



GROUND PLAN



FIRST FLOOR PLAN

SCALE 

OF FEET

Inv.

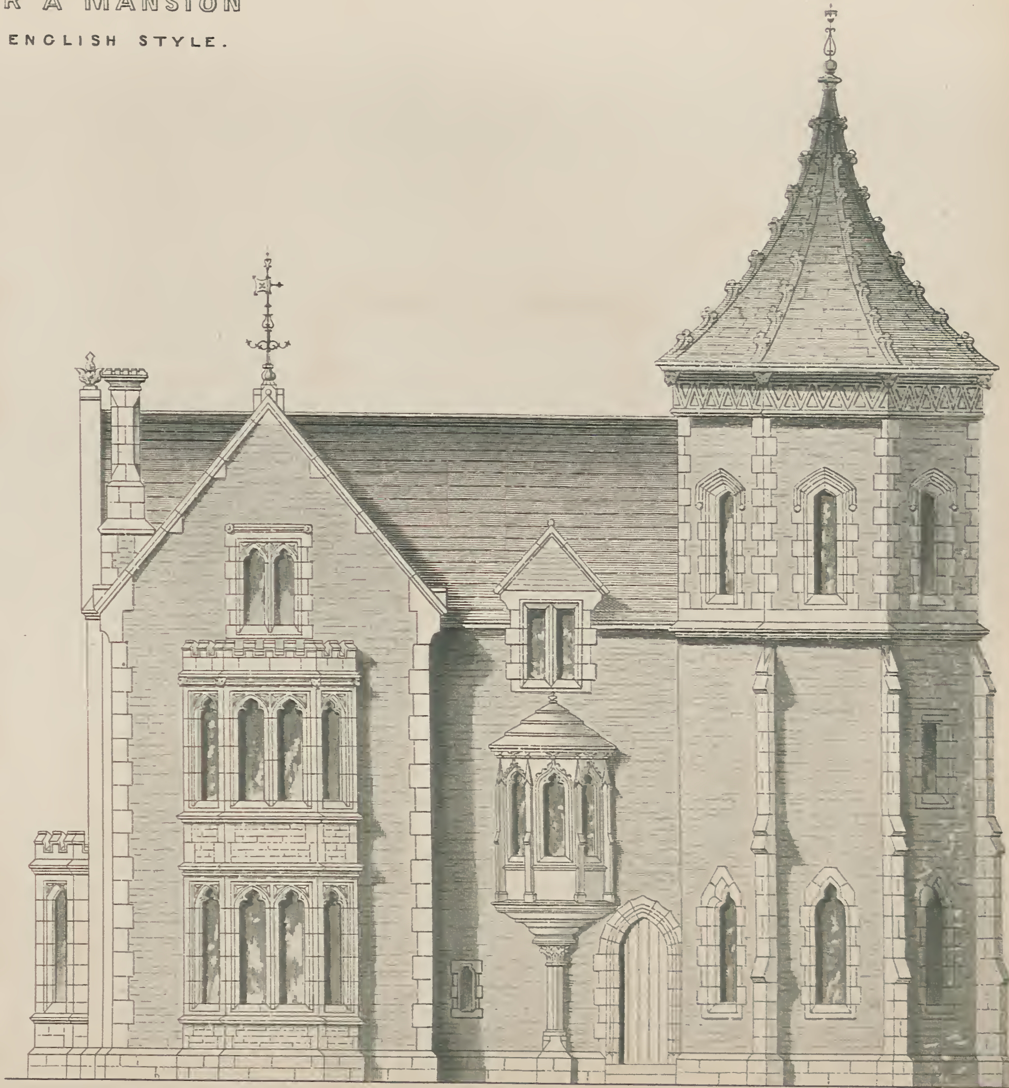
A. H. Payne sc.

Plate 98.

Design for a Mansion

IN THE OLD ENGLISH STYLE.

SIDE ELEVATION



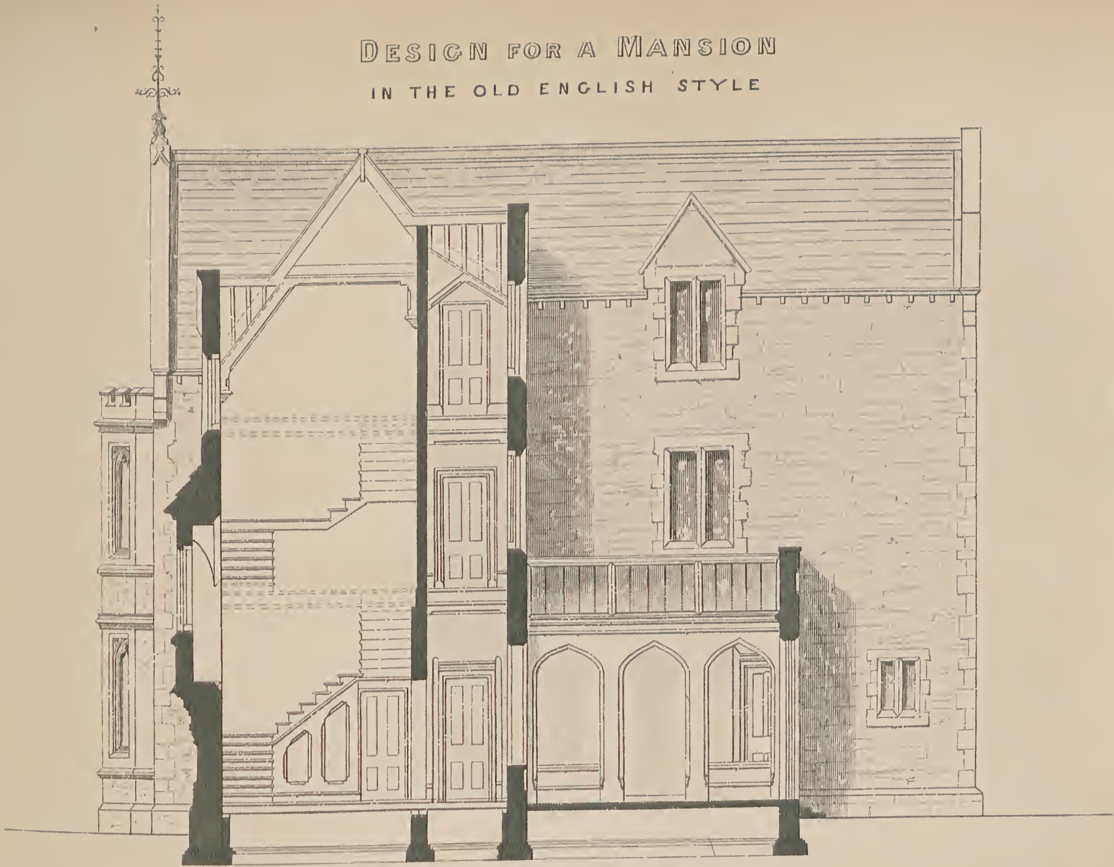
FRONT ELEVATION

SCALE OF 10 5 0 10 20 FEET

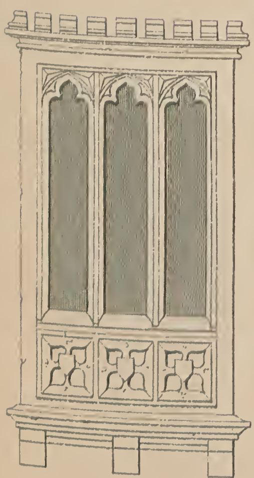
E. L. Tarbuck inv. A. H. Payne sc.

DESIGN FOR A MANSION

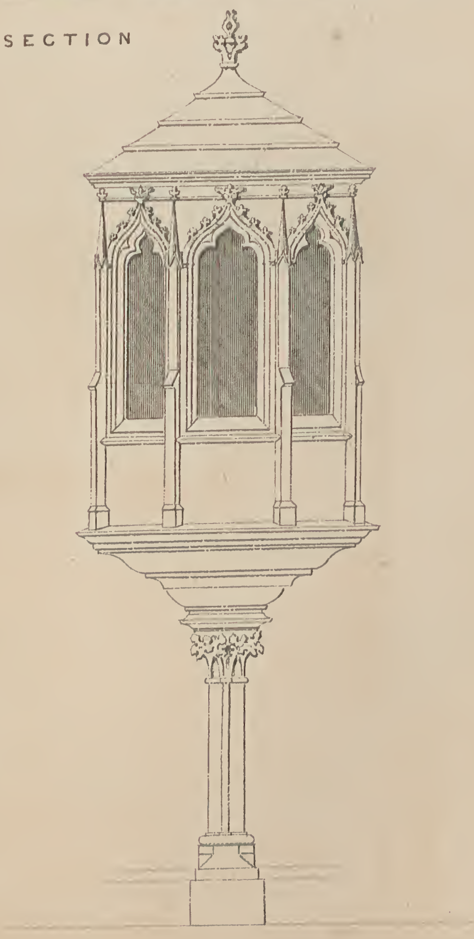
IN THE OLD ENGLISH STYLE



SECTION



DETAIL OF BAY
SIDE ELEVATION



DETAIL OF CIRCULAR WINDOW

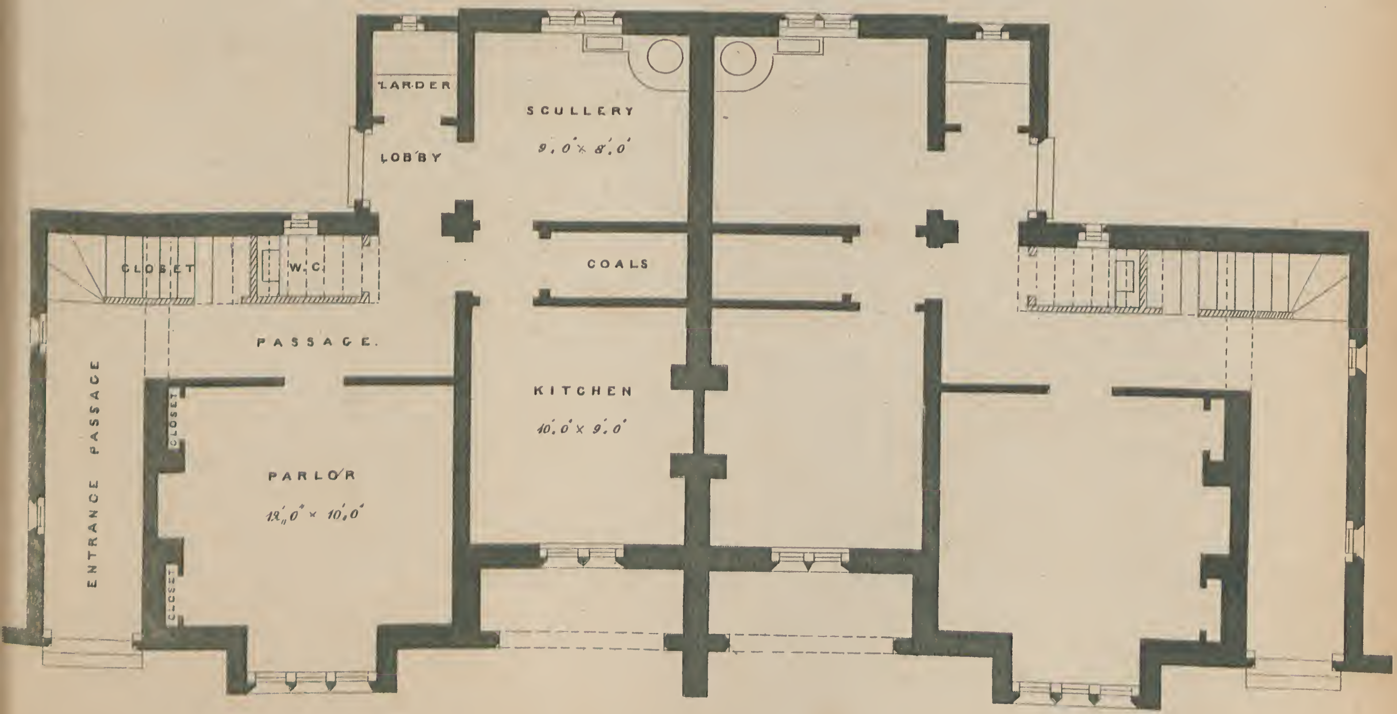
DETAIL OF FINIAL

SCALE OF 10 5 0 10 20 FEET

rbuck inv. A. H. Payne sc.

Design for a Pair of Six-Roomed Cottages.

FRONT ELEVATION

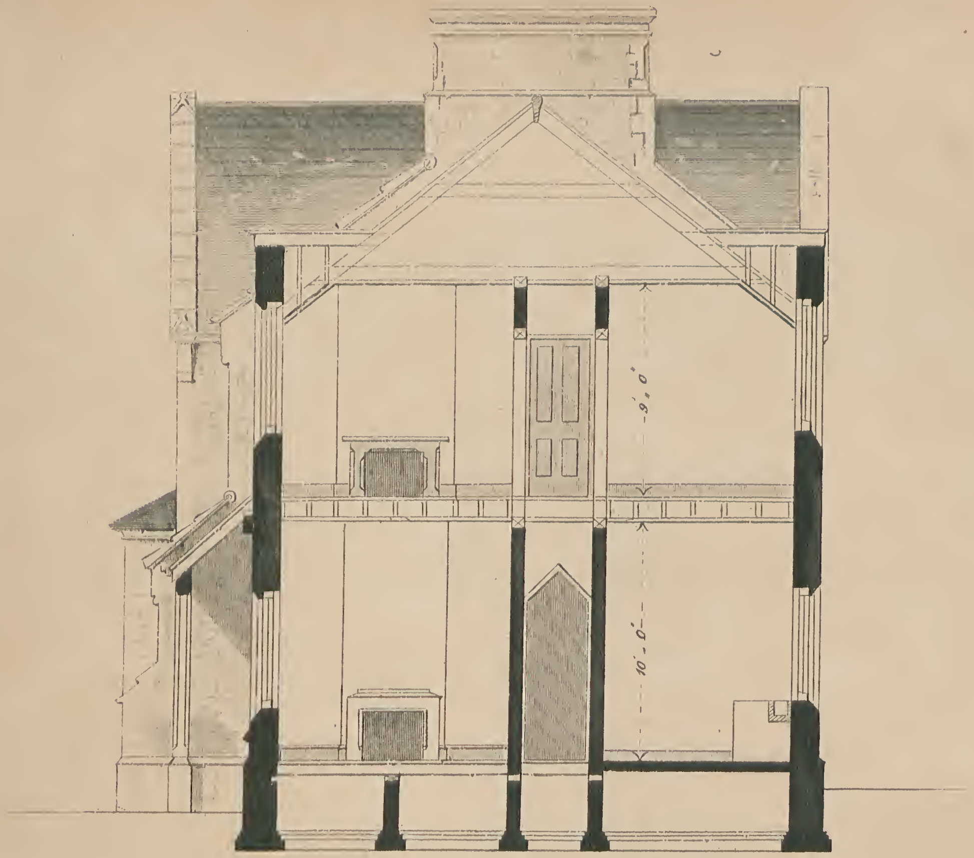


GROUND PLAN

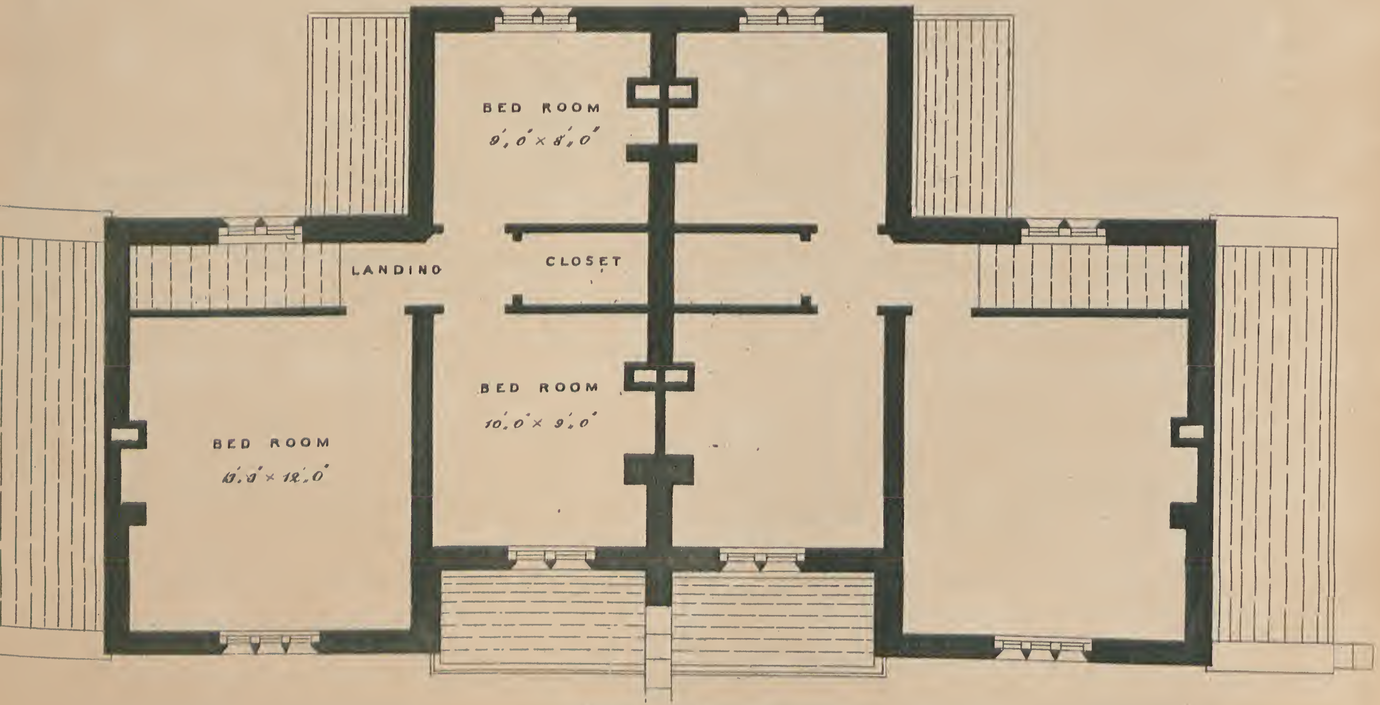
SCALE OF 10 5 0 10 FEET

Tarbuck inv.   A H Payne sc.

DESIGN FOR A PAIR OF SIX-ROOMED COTTAGES.



SECTION

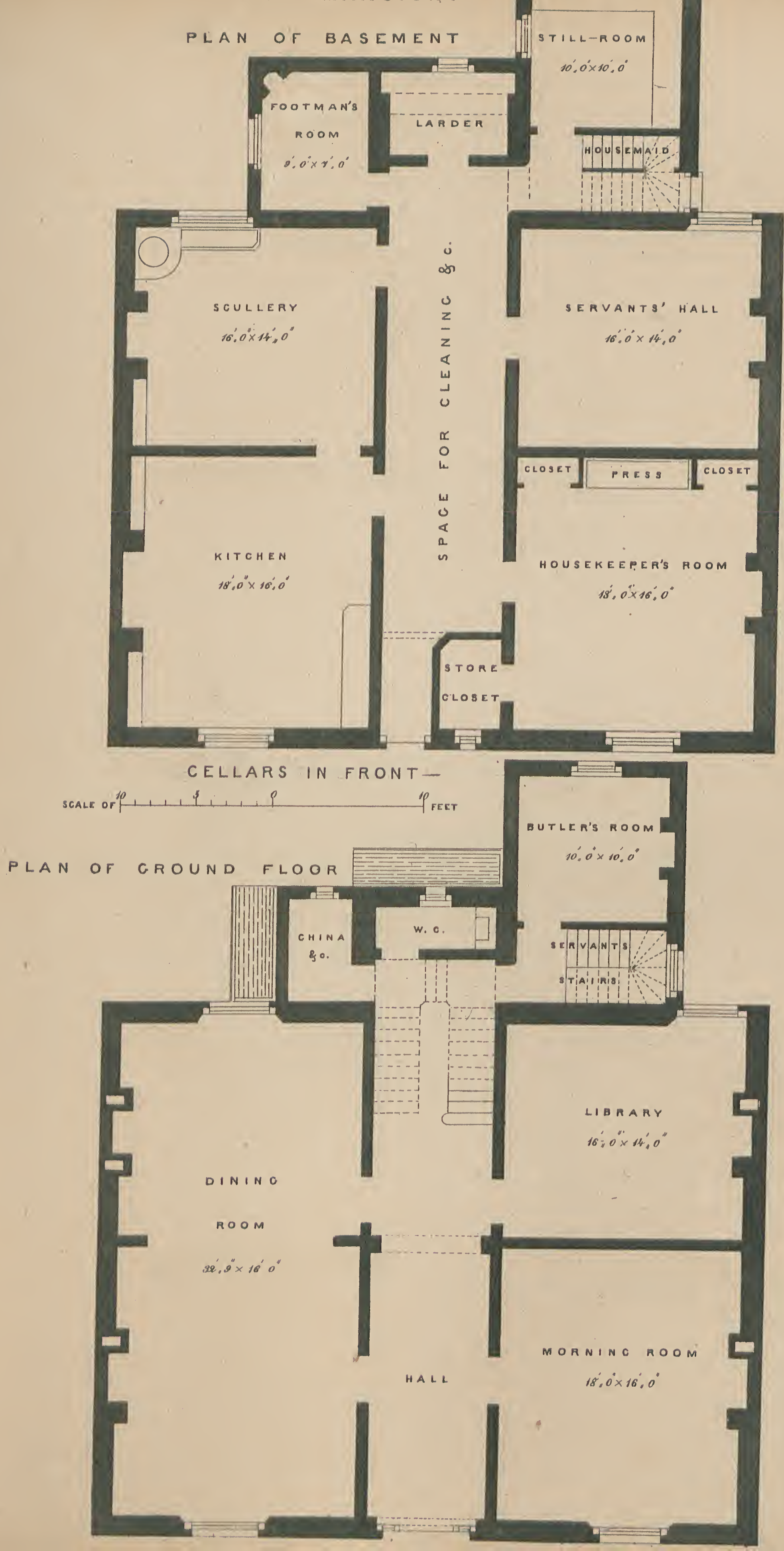


CHAMBER PLAN

SCALE OF 10 5 0 10 FEET

Tarbuck inv. A. H. Payne sc.

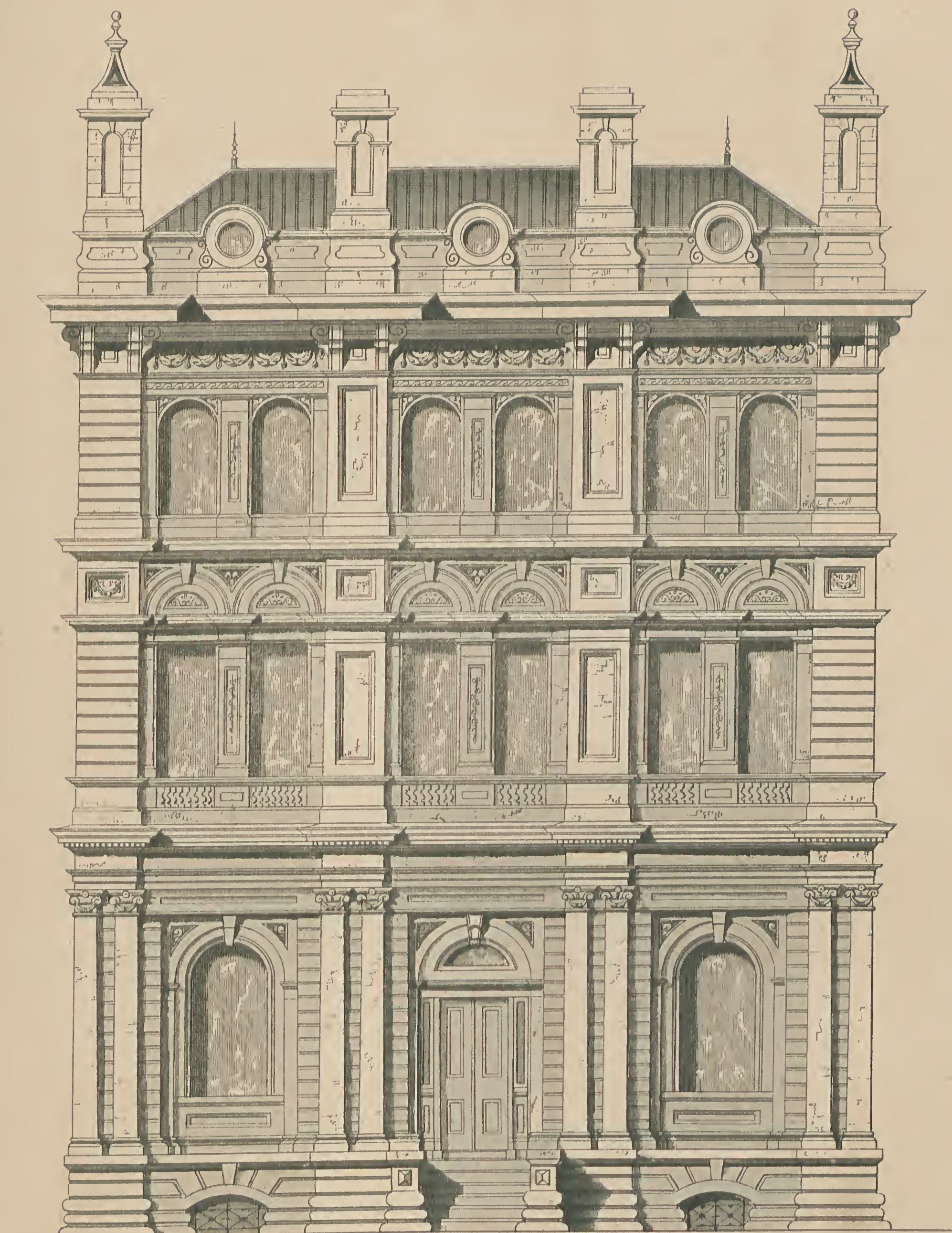
DESIGN FOR A FIRST CLASS TOWN MANSION.



A. H. Payne sc.

ILLUSTRATIONS OF STREET ARCHITECTURE.

DESIGN FOR A FIRST CLASS TOWN MANSION

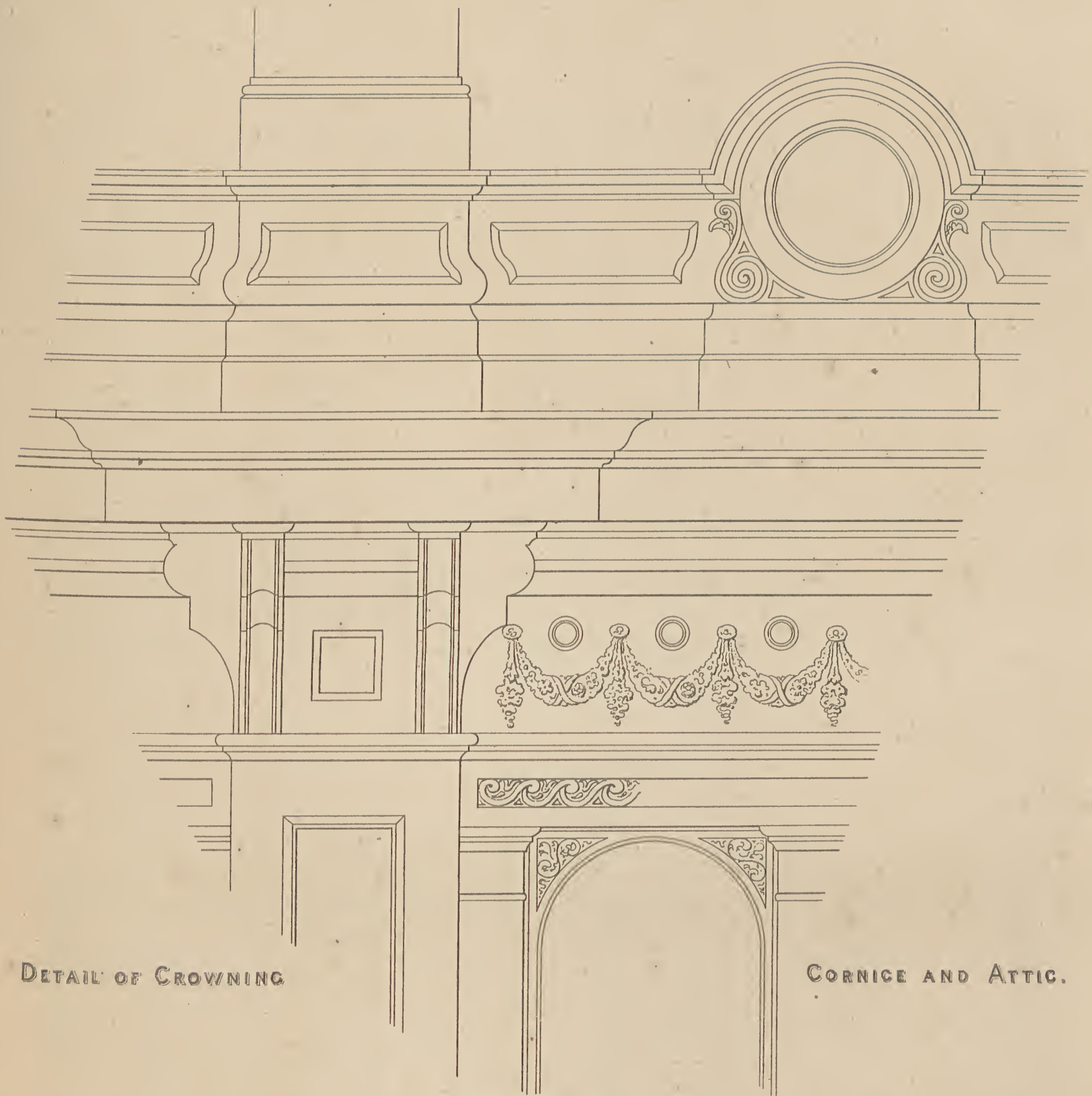


PRINCIPAL ELEVATION

SECTION THROUGH GROUND FLOOR WINDOWS.

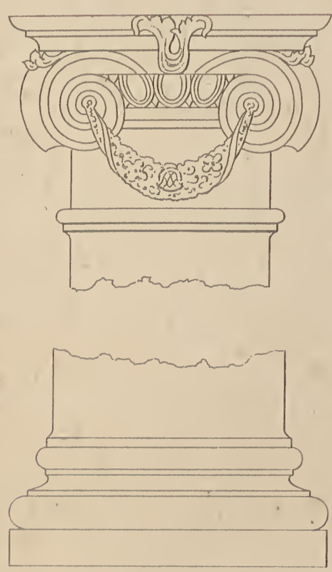
SCALE OF 10 5 0 10 20 FEET.

Tarbuck inv.



DETAIL OF CROWNING CORNICE AND ATTIC.

SECTION OF IONIC ENTABLATURE



IONIC PILASTERS.

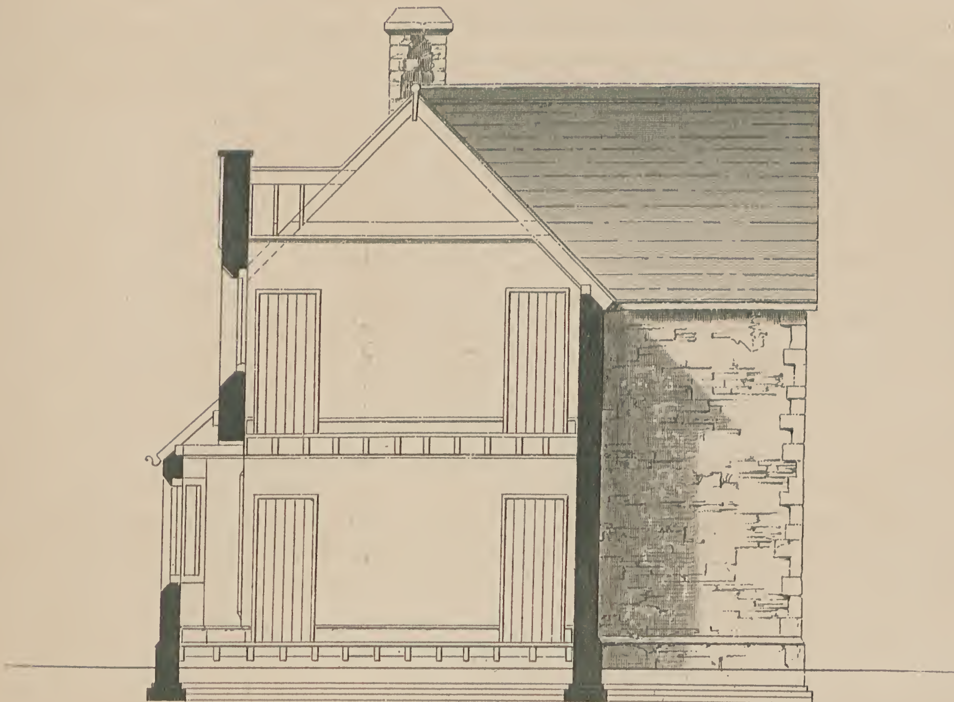
SECTION OF BASEMENT.

bule inv.

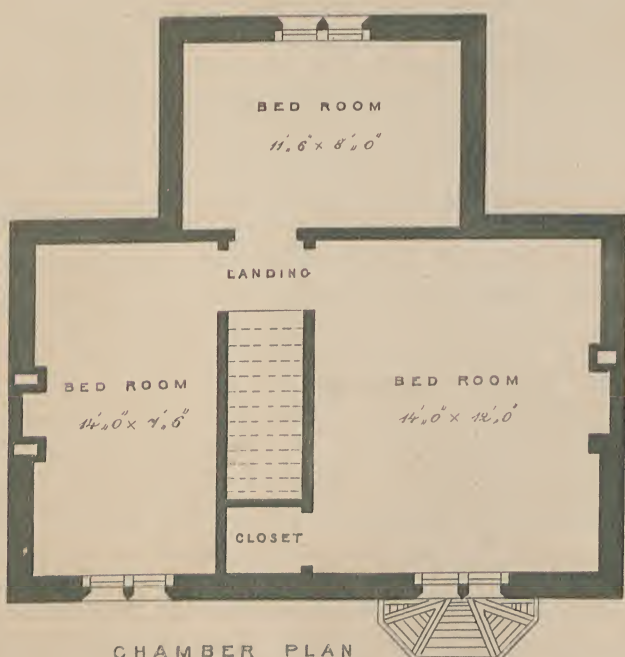
A. H. Payne

DESIGN FOR A MODEL COTTAGE

FOR LABOURERS, MECHANICS, &C.



SECTION

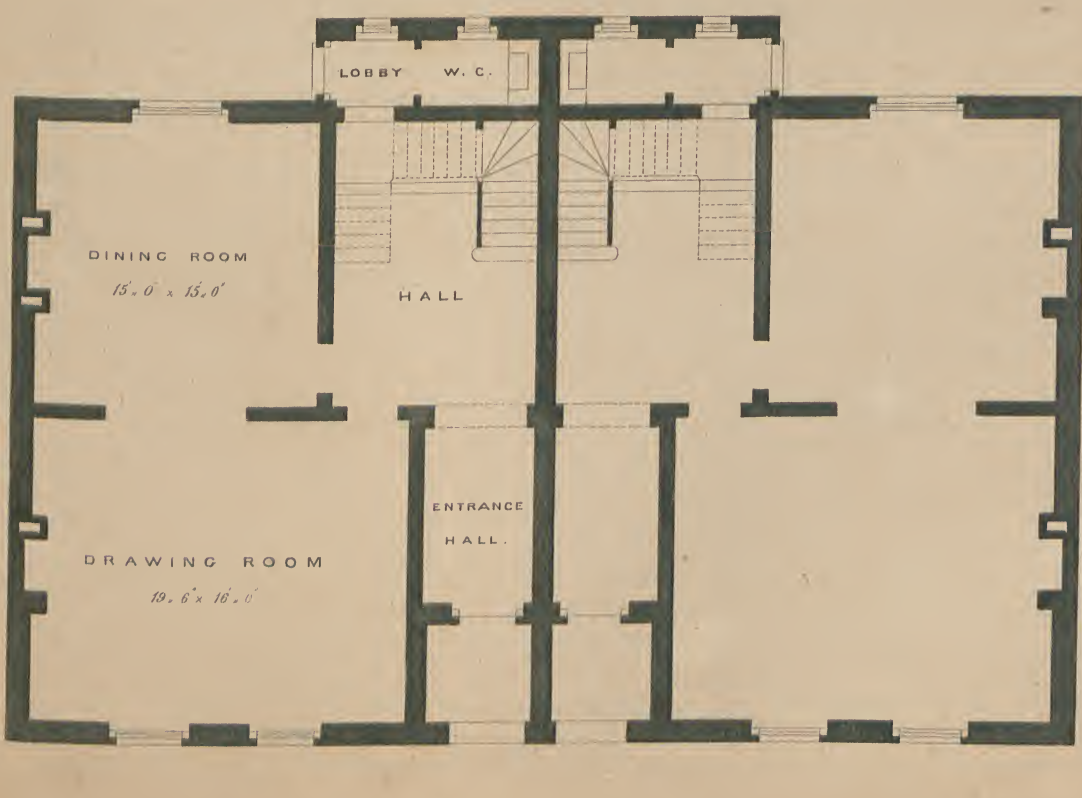


CHAMBER PLAN

SCALE OF 10 5 0 10 FEET

DESIGN FOR SEMI-DETACHED TOWN HOUSES

FRONT ELEVATION.



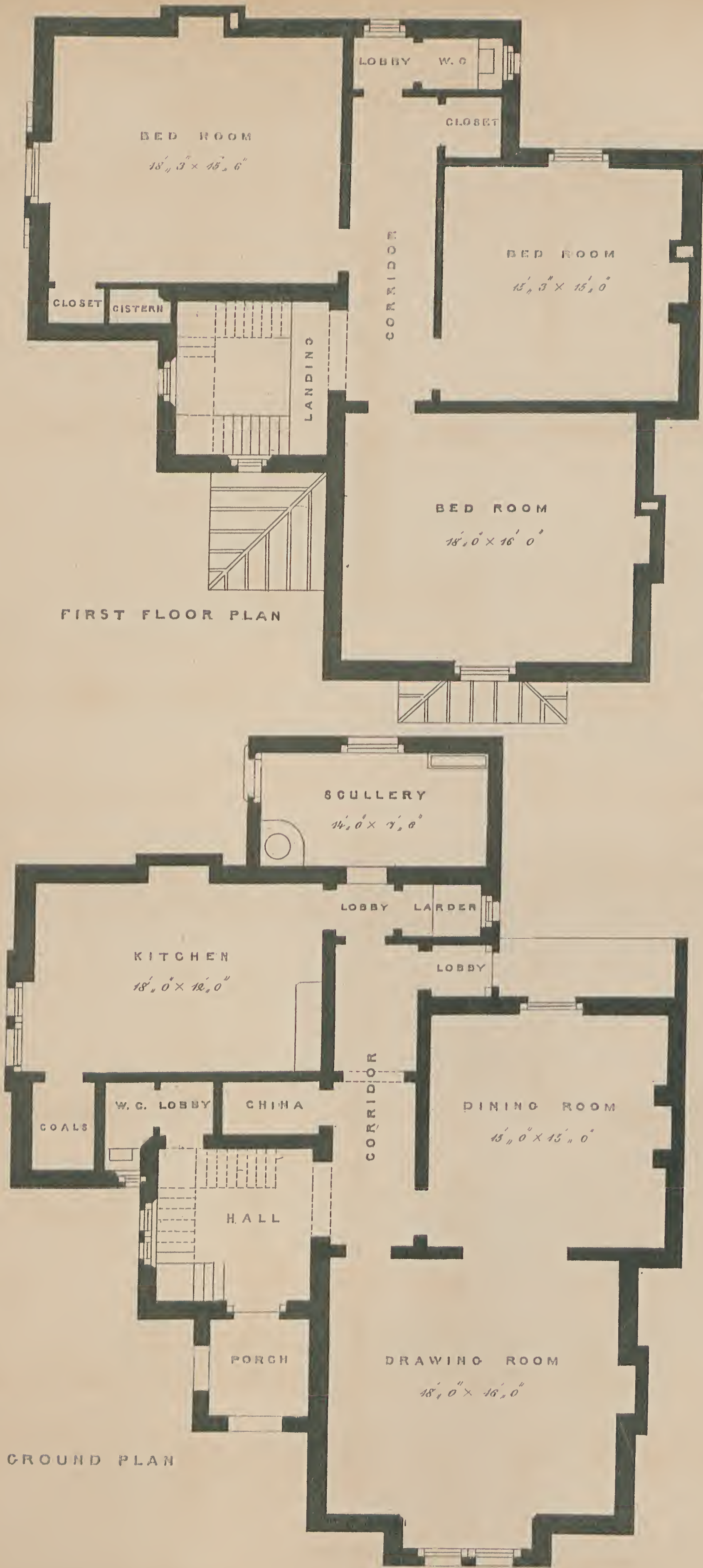
GROUND PLAN.

SCALE OF 10 5 0 10 20 FEET

A. H. Payne sc.

DESIGN FOR A SUBURBAN VILLA

Plate 114



...rbuck inv. SCALE OF ... 20 FEET

DESIGN FOR A SUBURBAN VILLA.

FRONT ELEVATION.

SIDE ELEVATION.

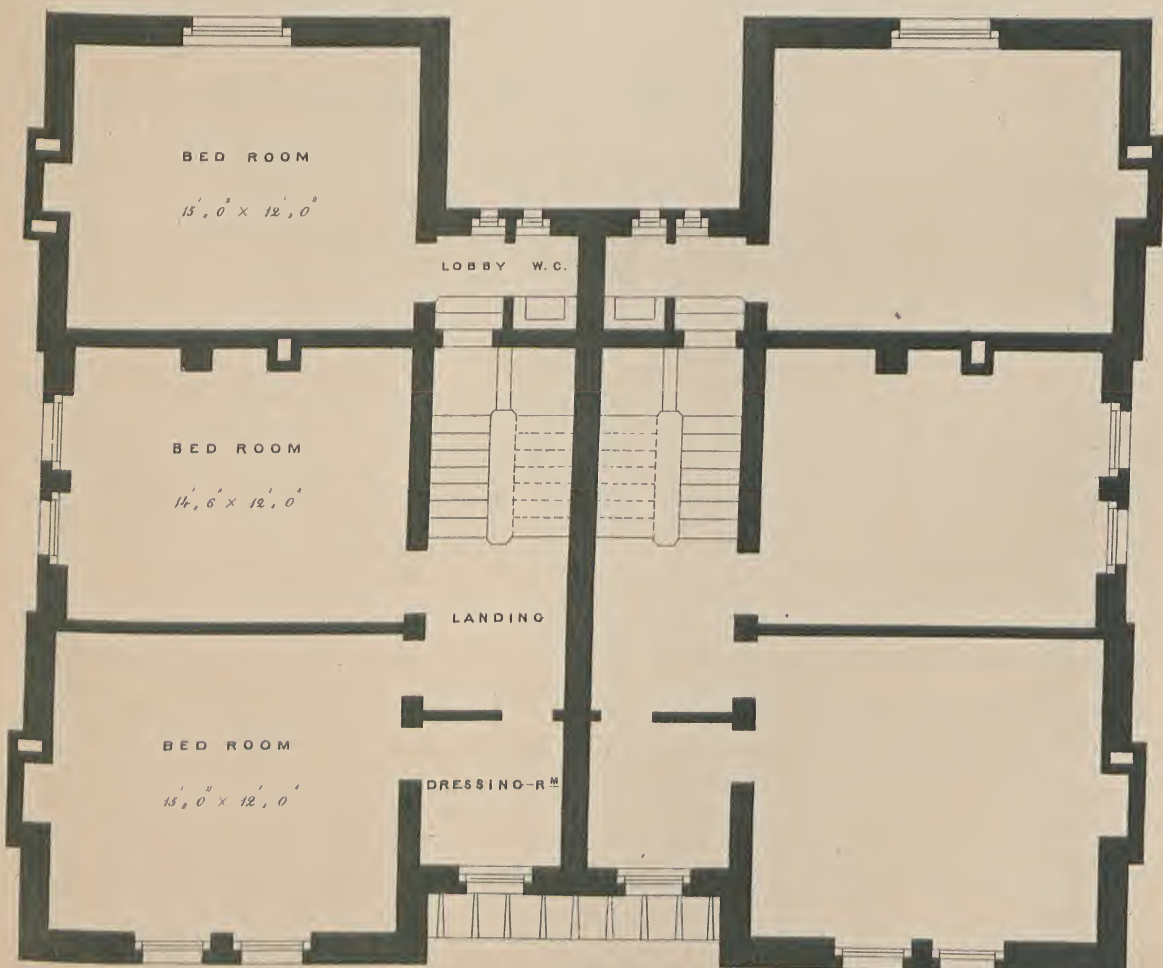
E. L. TARBUCK inv.

SCALE OF 10 5 0 10 20 FEET.

A. H. PAYNE sc.

DESIGN FOR A PAIR OF SEVEN-ROOMED VILLAS.

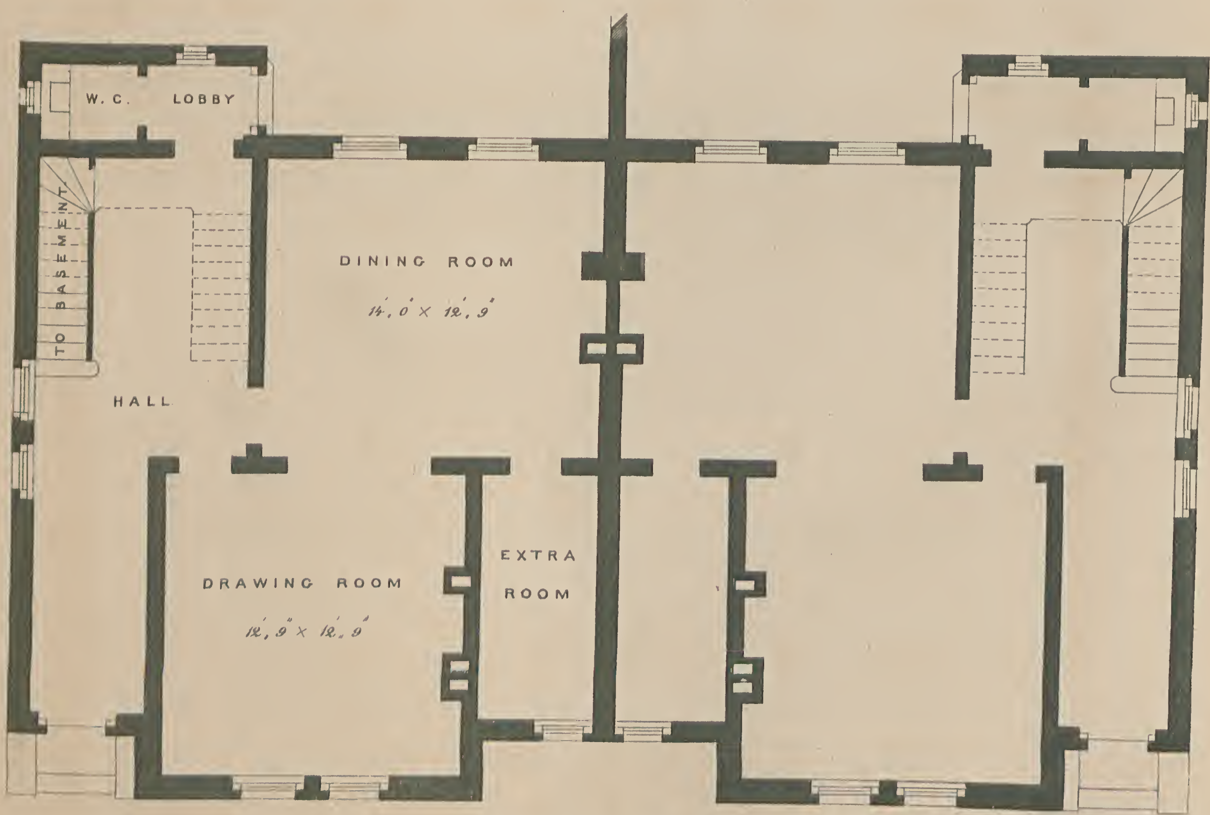
SIDE ELEVATION



CHAMBER PLAN

SCALE OF 10 5 0 10 FEET

FRONT ELEVATION.

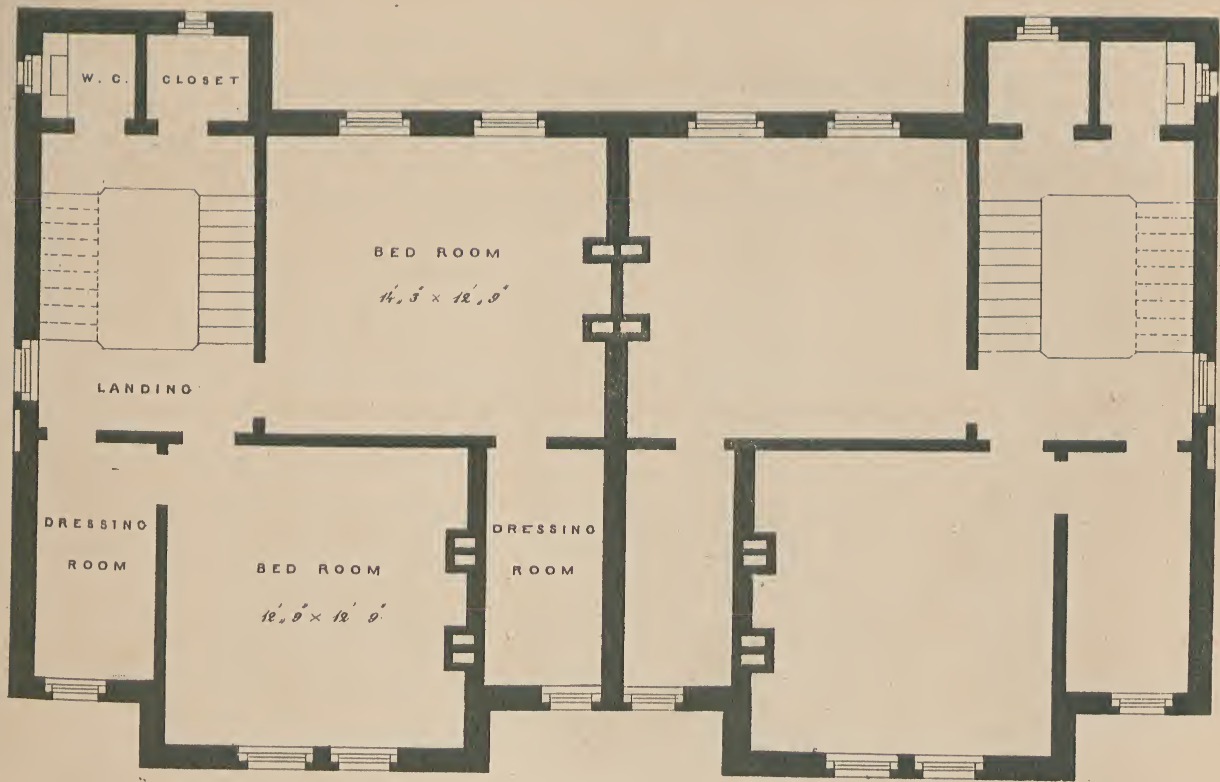


GROUND PLAN

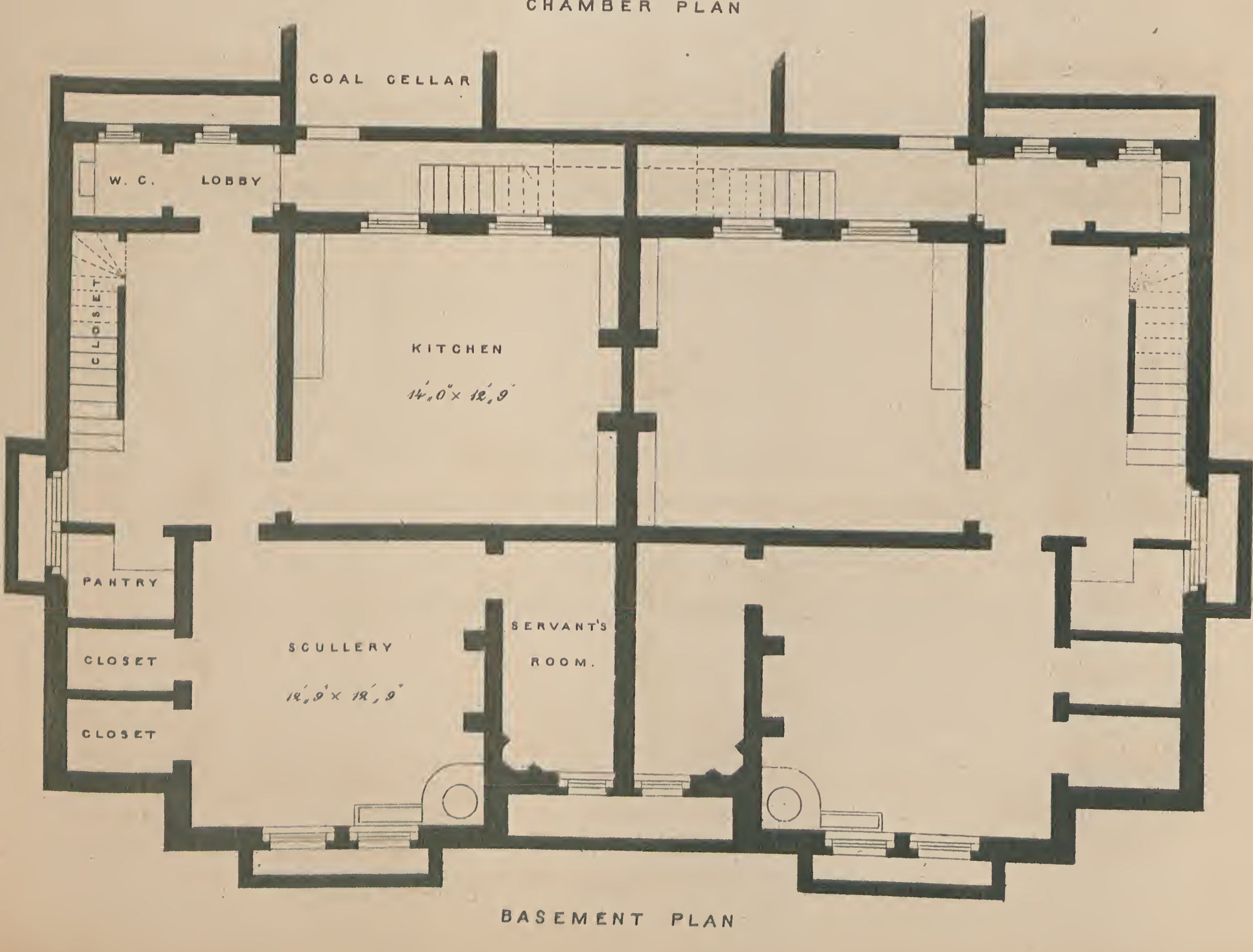
SCALE OF 10 5 0 10 FEET

...k inv. A. H. Payne sc.

DESIGN FOR A PAIR OF SUBURBAN HOUSES



CHAMBER PLAN

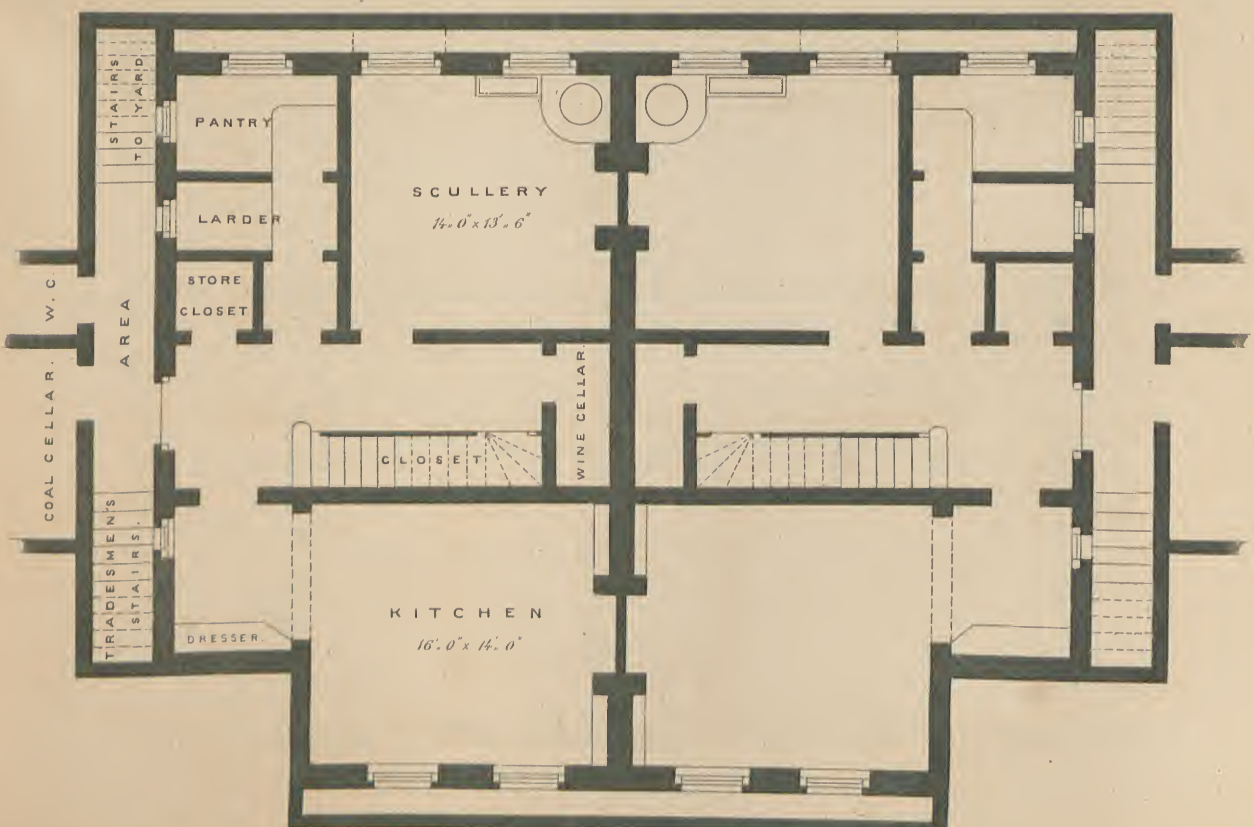


BASEMENT PLAN

SCALE OF FEET

DESIGN FOR A PAIR OF EIGHT-ROOMED HOUSES.

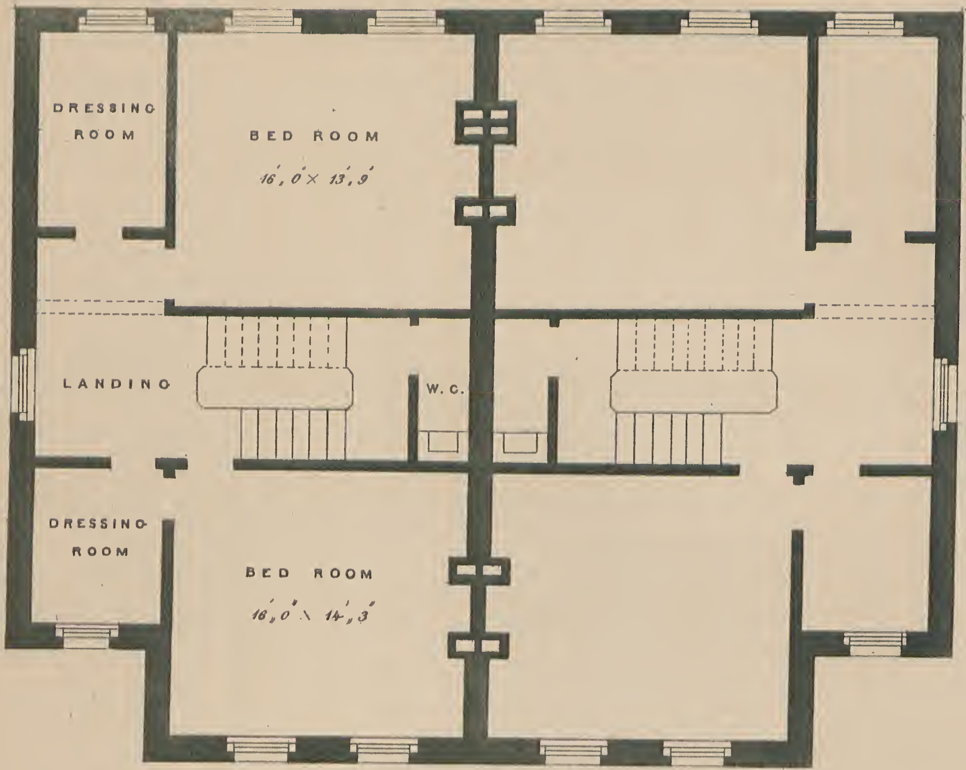
FRONT ELEVATION.



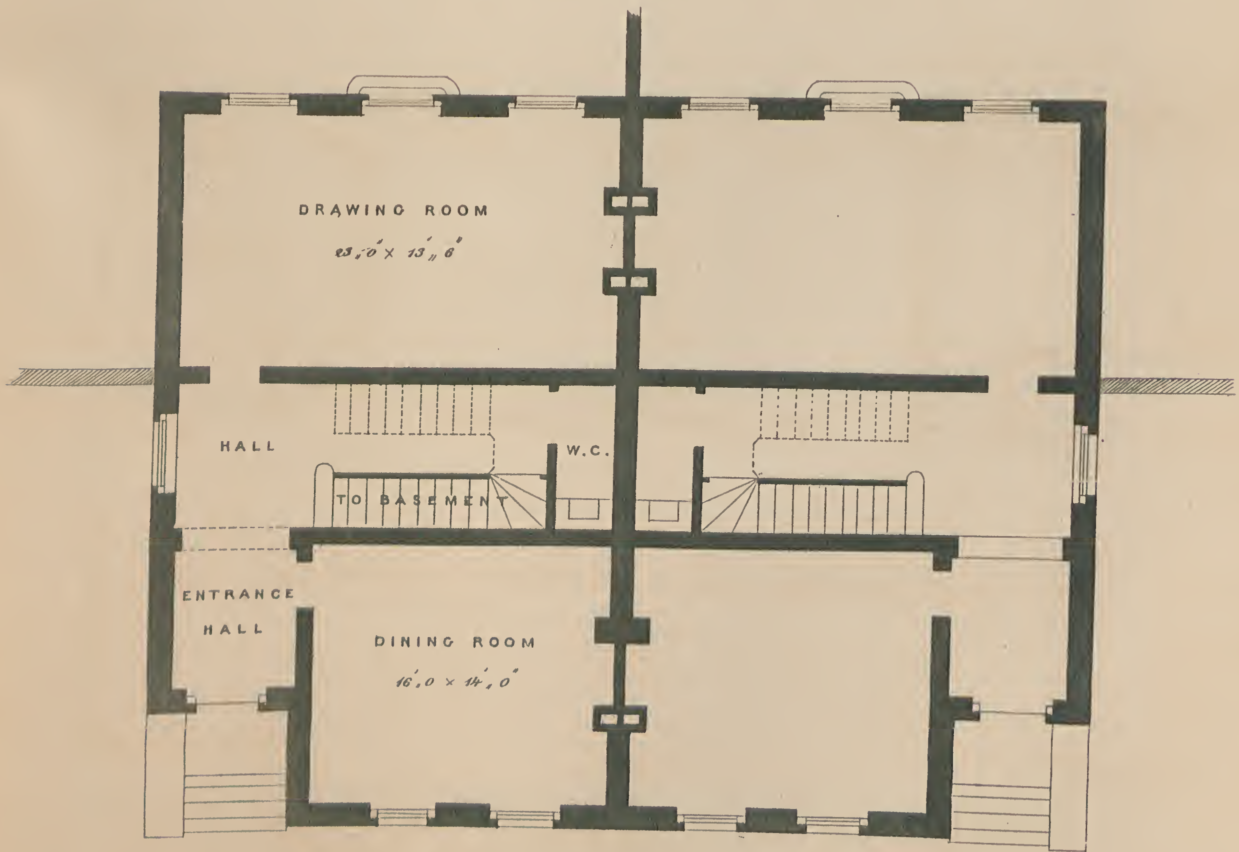
PLAN OF BASEMENT.

SCALE OF 10 5 0 10 20 FEET.

Design for a Pair of Eight Roomed Houses.

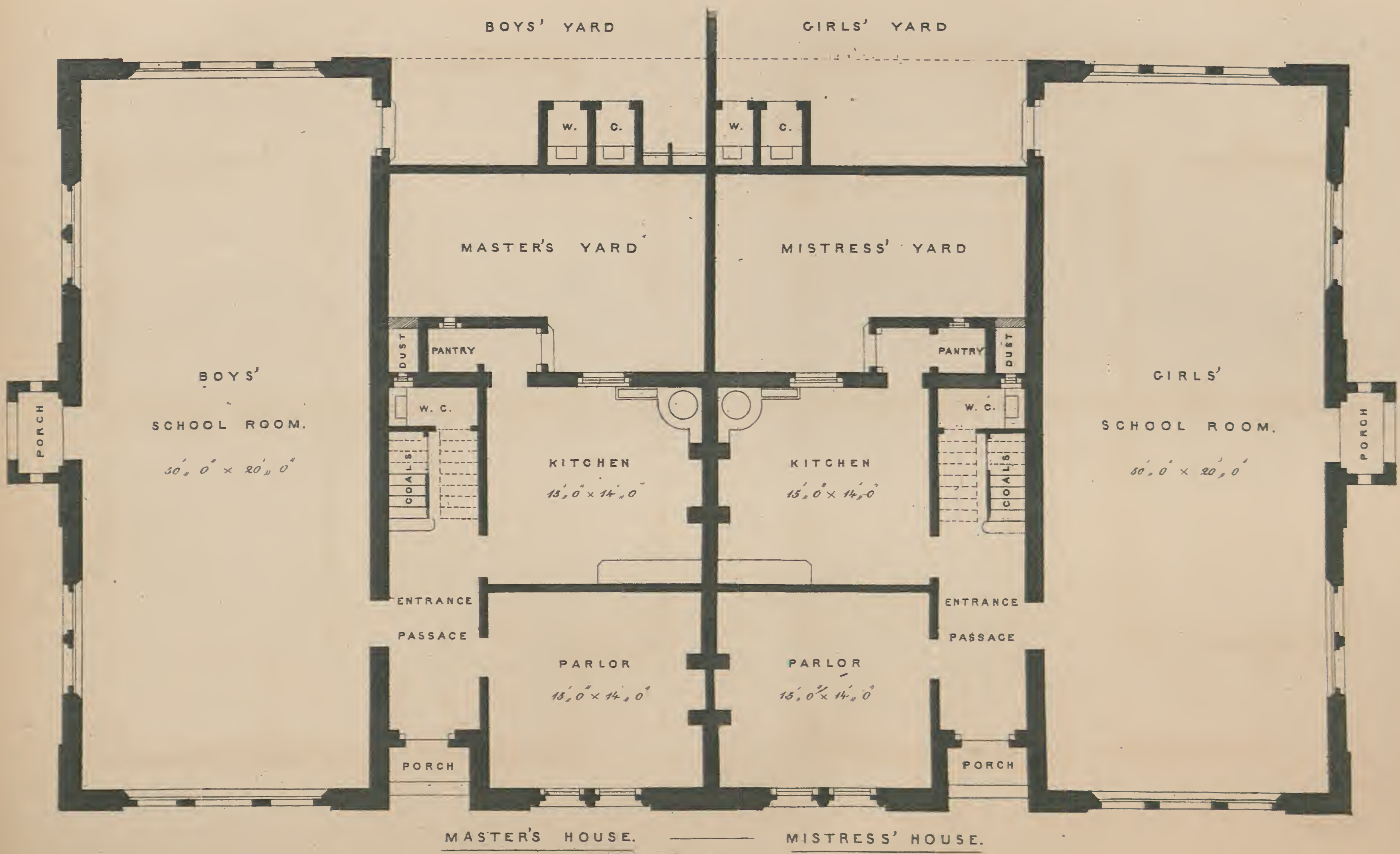


PLAN OF CHAMBER FLOOR.



PLAN OF GROUND FLOOR.

SCALE OF 10 5 0 10 20


BOYS' YARD
GIRLS' YARD
W. C.
W. C.
MASTER'S YARD
MISTRESS' YARD
DUST
PANTRY
PANTRY
DUST
BOYS'
SCHOOL ROOM.
50' 0" × 20' 0"
W. C.
COALS
KITCHEN
15' 0" × 14' 0"
KITCHEN
15' 0" × 14' 0"
W. C.
COALS
GIRLS'
SCHOOL ROOM.
50' 0" × 20' 0"
PORCH
PORCH
ENTRANCE
PASSAGE
ENTRANCE
PASSAGE
PARLOR
15' 0" × 14' 0"
PARLOR
15' 0" × 14' 0"
PORCH
PORCH
MASTER'S HOUSE.
MISTRESS' HOUSE.

GROUND-PLAN.

DESIGNS FOR SCHOOLS AND RESIDENCES.

PRINCIPAL - ELEVATION.

Scale of 10 5 0 10 20 Feet.

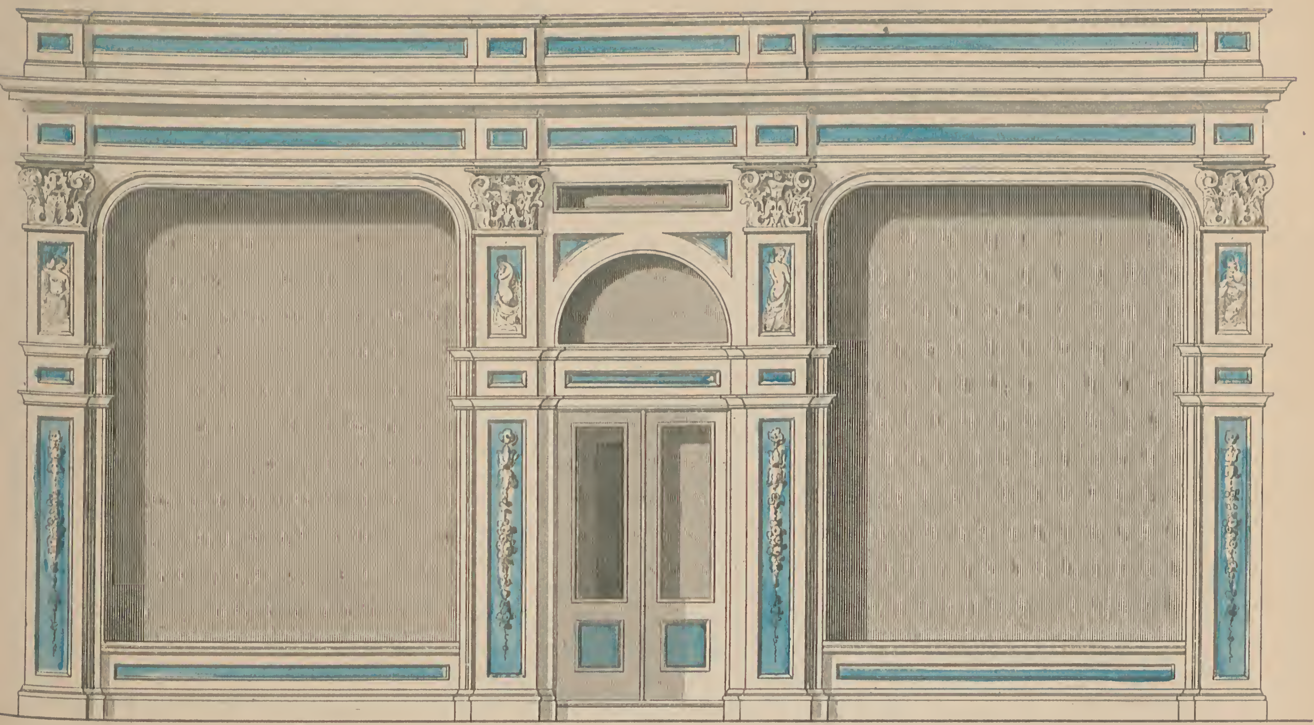
Plate 125.

Designs for Schools and Residences.

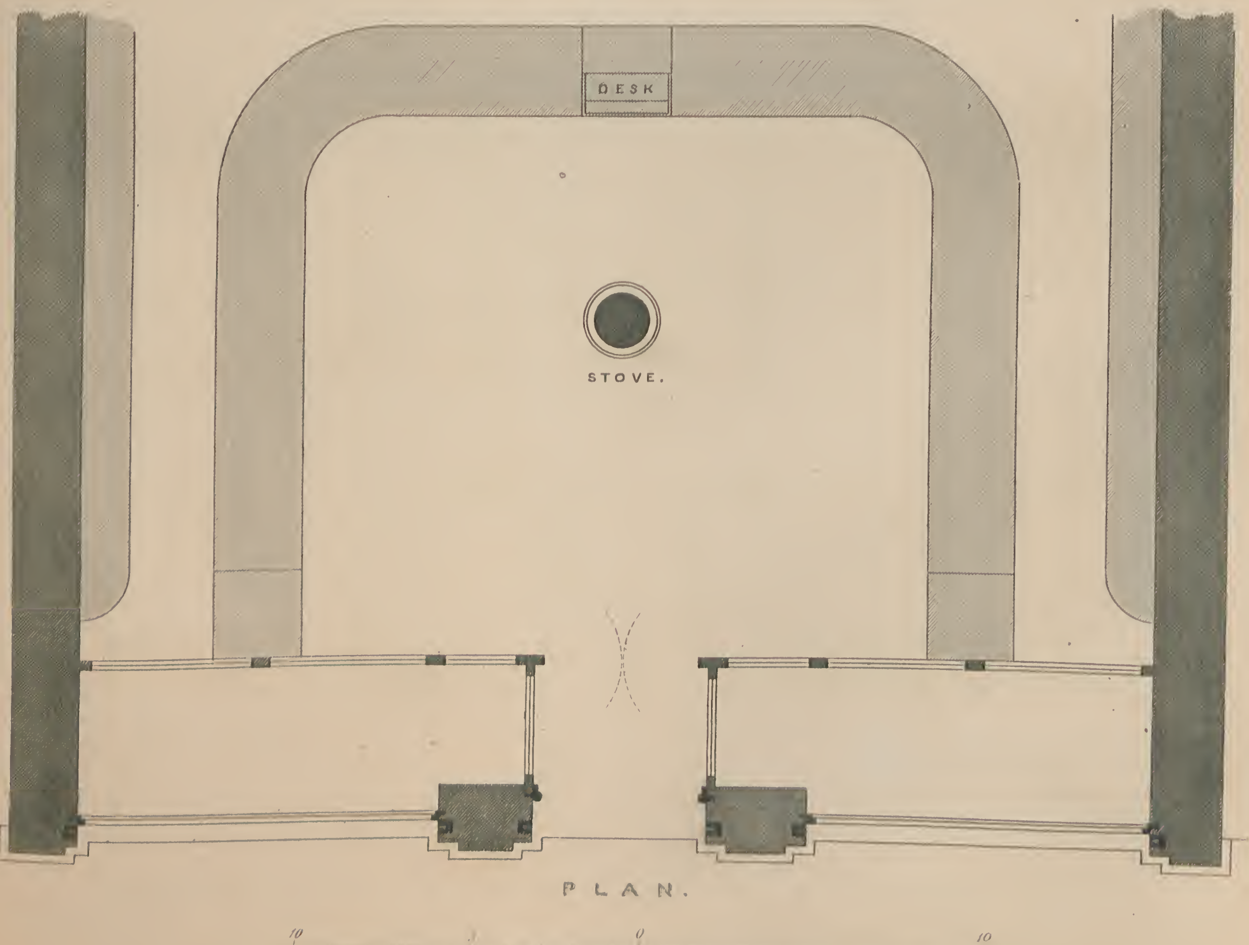
LONGITUDINAL — SECTION.

Scale of 10 5 0 10 20 Feet.

DESIGN FOR A SHOP-FRONT.



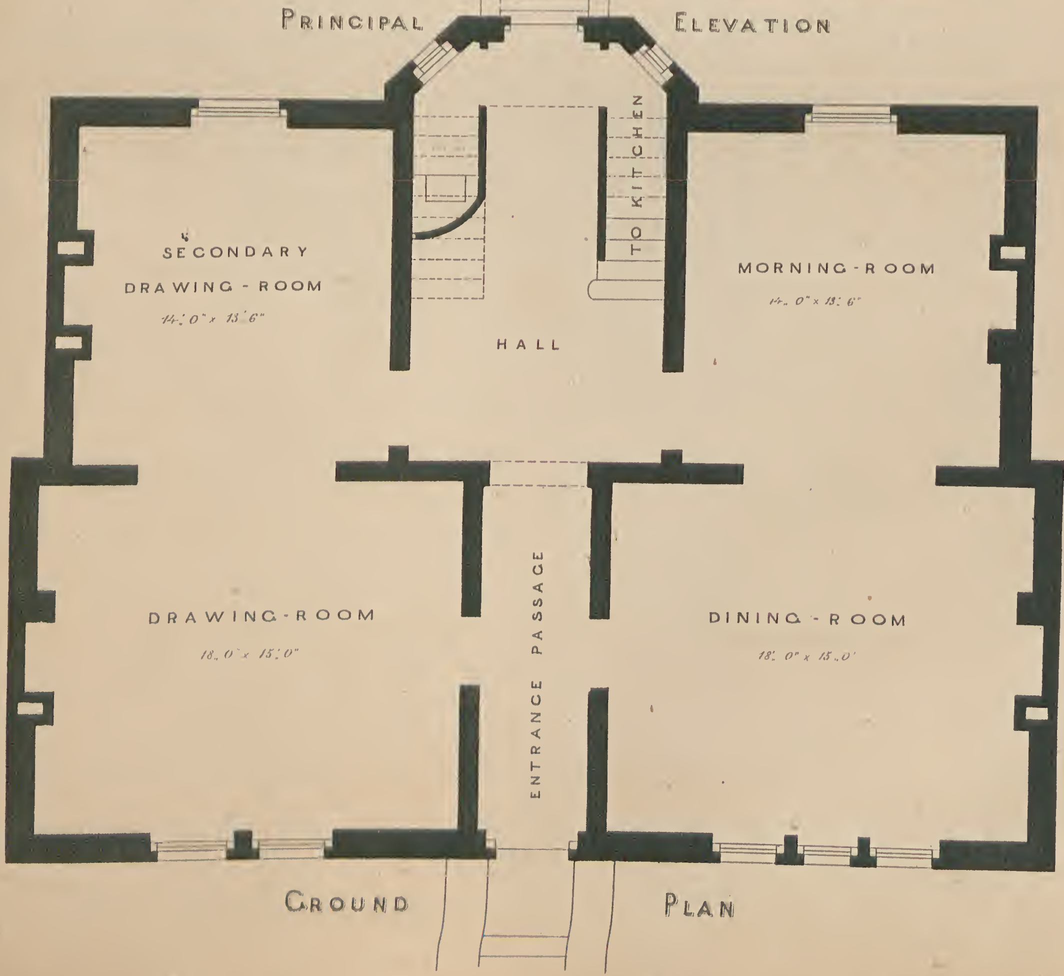
ELEVATION.



PLAN.

SCALE OF 10 0 10 FEET.

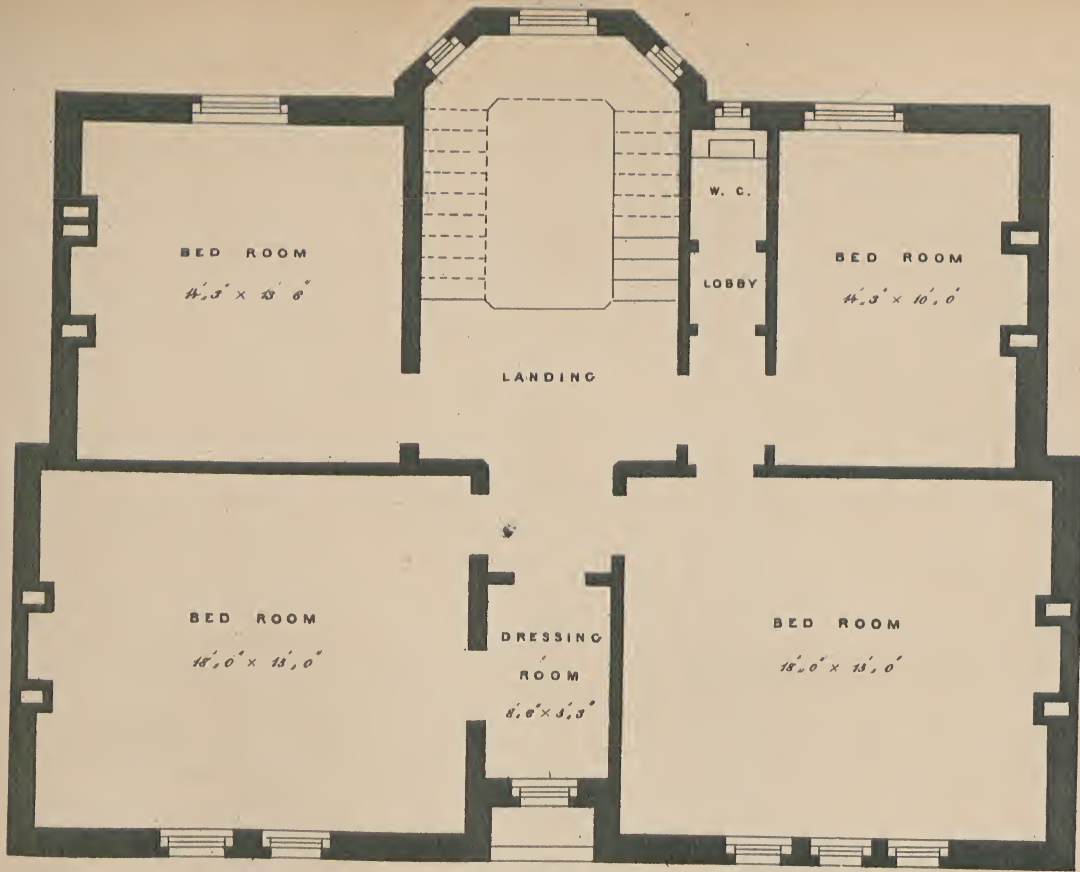
PRINCIPAL ELEVATION



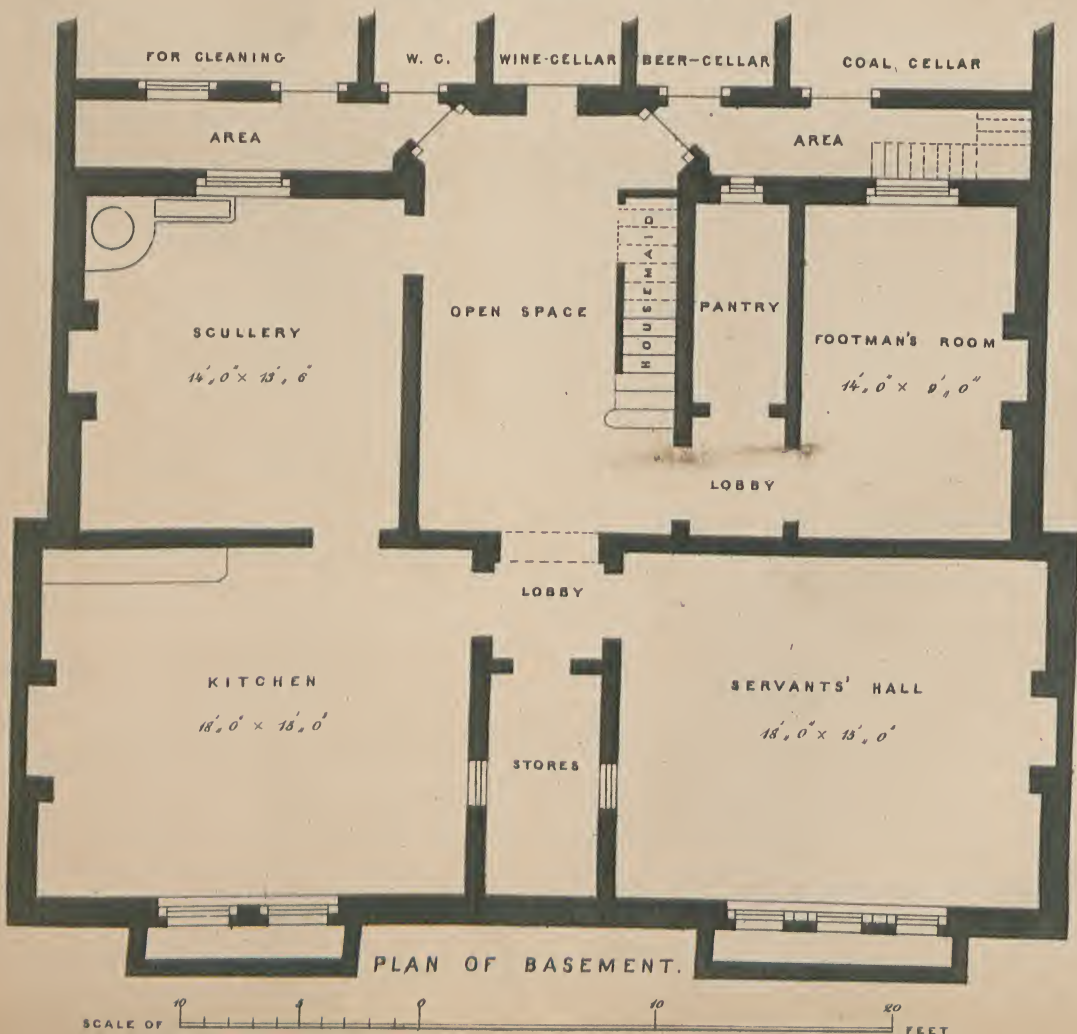
GROUND PLAN

SCALE OF FEET

DESIGN FOR A DETACHED VILLA —



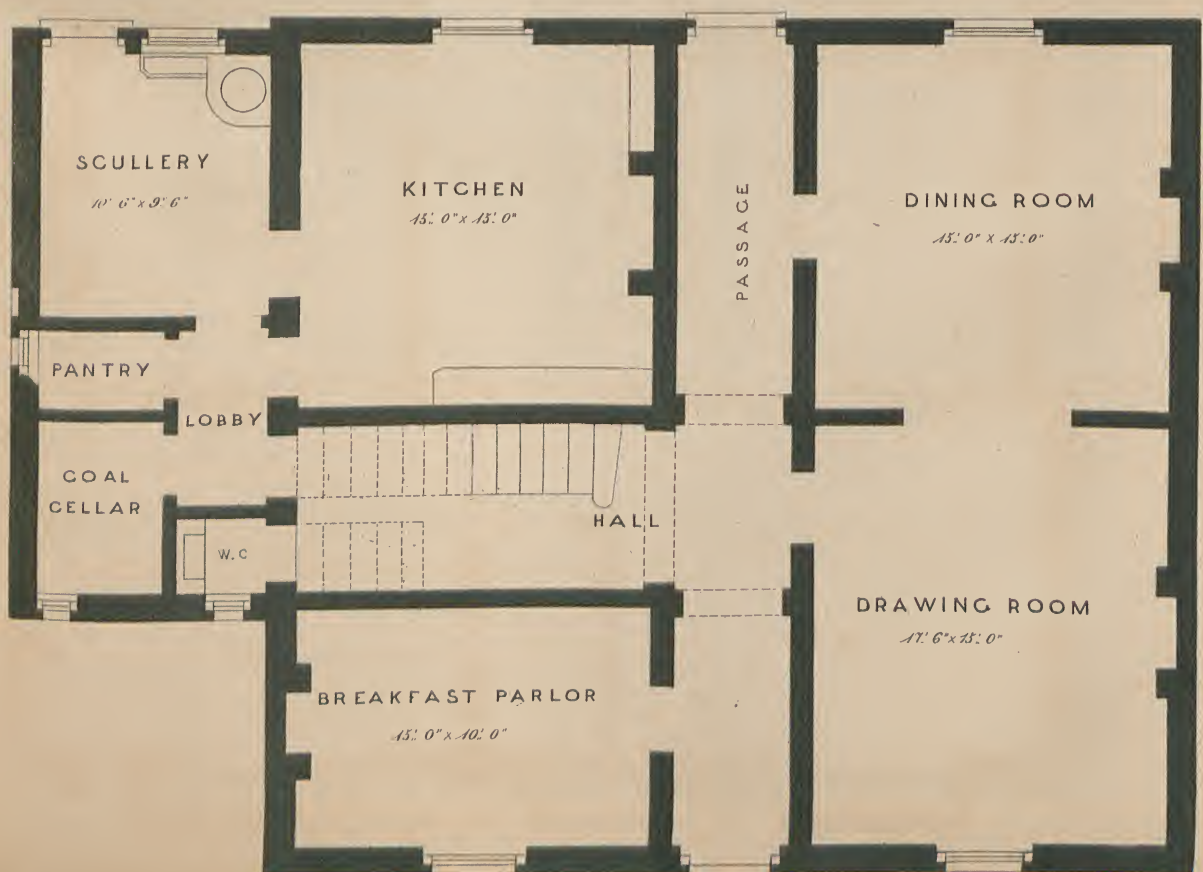
PLAN OF FIRST FLOOR.



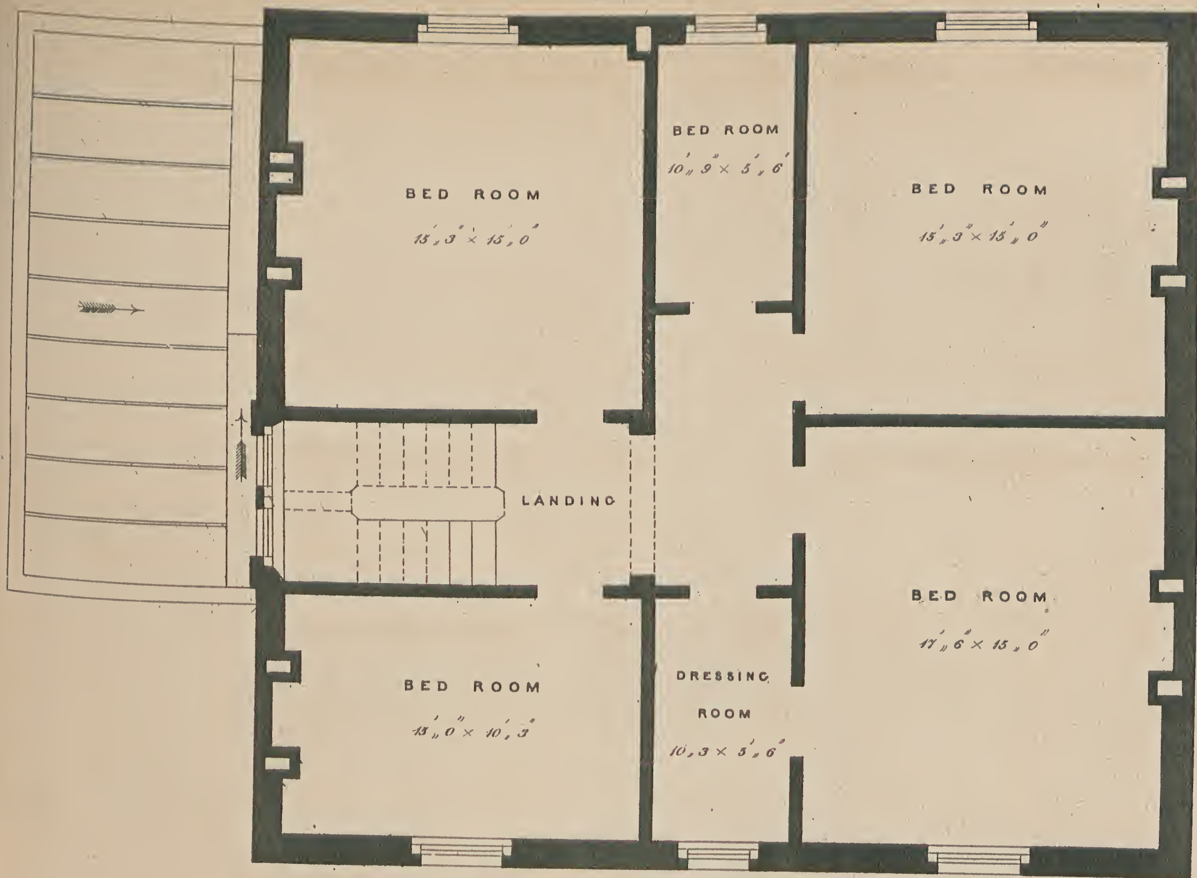
PLAN OF BASEMENT.

Design for a Detached Town House.

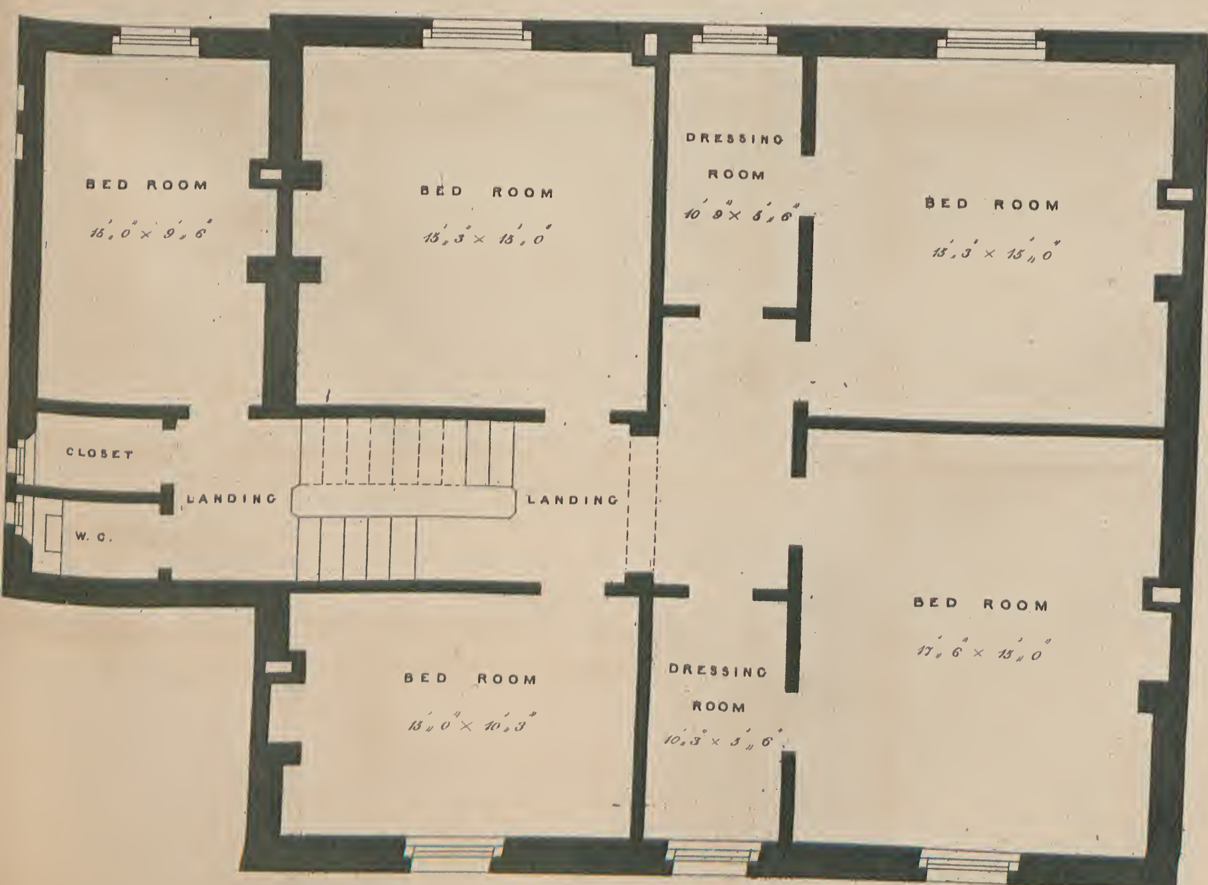
Principal Elevation.



DESIGN FOR A DETACHED TOWN HOUSE.



SECOND FLOOR PLAN



FIRST FLOOR PLAN

inv. SCALE OF 10 5 0 10 20 FEET

THE BUILDER'S

PRACTICAL DIRECTOR.

SUPPLEMENTARY SERIES.

PREFACE.

The Builder's Practical Director was intended to comprise within its limits such a comprehensive view of the details of Building Operations as would be of the greatest utility, not only to those personally engaged in them, but also to that extensive class desirous of gaining such an insight into the subject, as would enable them to superintend the progress of their works. It has been found impossible to comprise within the limits originally proposed, and to which the publishers desired to keep much necessary matter alluded to in early numbers, as well as subjects of practical importance which several subscribers experienced in building have kindly suggested as constantly recurring wants, and evidently extremely useful to those who are not versed in the details of Construction. The Art of Warming and Ventilating rooms with economy, the Supply of Water; the best methods of Drainage, brief Statements of the Laws affecting Landlords and Tenants, Dilapidations and Buildings generally, many valuable Suggestions respecting the different Building Trades, Tables of Scantlings and Quantities of Timber, Deals etc., Brickwork, Plastering and Painting, as well as Remarks on Estimating, Measuring and Valuing, are some of the subjects necessarily omitted for want of space and now proposed to be treated in a *Supplementary Series*, consisting of a limited number of Parts, and comprising with the original Work, a complete Body of Information on the subjects to which it relates.

The Designs accompanying the Text will be of an entirely novel description, of equal utility and importance to those given. They are introduced, as well because peculiarly in demand at the present moment, as to complete in this Supplement the whole of the subjects which the Subscribers will be most likely to require, and thus render the Work of an Universal, instead of, as hitherto, a limited character. We are not aware of any book which places within the reach of the Million the class of Designs now proposed to be given, and certainly there is not one, accom-

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panied as this will be, with Detailed Working Drawings, Specifications and Estimates, presenting facilities practically to superintend and carry out Buildings. The great demand which a late Act of Parliament has caused for Cemetery Chapels will render these, with their Lodges and Entrances, an important feature, and Designs will also be given for Tablets and Memorial Slabs. Chapels, in Gothic, Italian and other architecture, Schools, Conservatories, Clock Turrets, and other useful subjects will be included, as well as Details of the Internal and External, Finishings of Shops and Warehouses. Working Drawings of Plasterer's work, Ceilings and Cornices, Ironwork, Chimney Pieces, and other Internal Fittings of Domestic Habitations, will also be occasionally interspersed.

THE METROPOLITAN BUILDING ACT, 1855.

The object of this Abstract is to give in a condensed, clear form, with explanations, such portions of the Act as more particularly require the attention of Builders, omitting the parts relating to the District Surveyors, the returns they are to make to the Metropolitan Board and other matter with which the general public have little to do, but the sections containing omitted matter will be all indicated. The Abstract will be found of essential use in presenting within a narrow compass all that is absolutely requisite to enable the builder to carry out his works. A few more important passages relating to building in the Metropolis Local Management Act are added. The marginal references will facilitate consultation and save loss of time; and the Schedules, which in the Queen's Printers' edition are at the end of the Act, are here placed in what is conceived to be their more appropriate place, viz. where referred to in the first part of the Act, thus bringing together all relating to construction. The numbers are those of the sections.

AN ACT TO AMEND THE LAWS RELATING TO THE CONSTRUCTION OF BUILDINGS IN THE METROPOLIS AND ITS NEIGHBOURHOOD.

(18. *and* 19. *Victoria, Cap.* 122. 14. *August*, 1855.)

1. This Act may be cited for all purposes as the Metropolitan Building Act, 1855. Title.

2. The Act comes into operation on the 1st January, 1856. Commencement.

3. Public Building means every building used as a place of worship, and for purposes of public instruction; also every building used as a college, public hall, hospital, theatre, public concert, ball, lecture, or exhibition room, or for any other public purposes. Interpretation of Terms.

External wall applies to every outer enclosure of any building, not being a party wall.

Party wall is every wall used to separate one building from another with a view to occupation by different persons.

Cross wall applies to every wall used to separate one part of any building from another part of the same building being wholly in one occupation.

Party structure includes party walls, partitions, arches, floors, and other structures separating buildings, stories or rooms, which belong to different owners, or which are approached by distinct staircases or separate entrances from without.

Area is a horizontal section of a building at the point of its greatest surface, including the external walls and such portion of the party walls as belong to the building, but excluding any attached building the height of which does not exceed the height of the ground story. The base of the wall is the course immediately above the footings. Owner applies to any person in receipt of the whole or any part of the rents or profits of any land or tenement, or in the occupation of such land or tenement other than as a tenant from year to year, or for ʌuʊ less term, or as a tenent at will.

Builder includes the master builder or other person employed to execute, or who actually executes any work upon the building. District Surveyor includes also any deputy appointed under this Act. In all cases in which a local officer having jurisdiction in respect of his office is referred to without mention of the locality to which the jurisdiction extends, such reference is to be understood to indicate the officer having jurisdiction in the place within which is situate the building or other subject matter to which such reference applies. Person includes a body corporate.

LIMITS OF ACT.

Limits.

4. The act extends to all places defined by *the Act for the better Local Management of the Metropolis,* and to all places to which such last mentioned Act may be extended, unless such places are expressly excepted from the operation of this Act; but nothing herein affects the powers of the Commissioners of the City of London.

Division of Act.

5. The Act is divided into five parts: — the first relating to the regulation and supervision of buildings; the second to dangerous structures; the third to party structures; the fourth to miscellaneous provisions; the fifth to the repeal of former acts and to temporary provisions.

PART I.
REGULATION AND SUPERVISION OF BUILDINGS.

Buildings exempted.

6. The Buildings exempted are: — Bridges, piers, quays etc., buildings employed for Her Majesty's use or service, buildings belonging to Companies cited or exempted under Acts of Parliament.

All buildings not exceeding in height thirty feet, as measured from the footings of the walls, and not exceeding in extent one hundred and twenty five thousand cubic feet, and not being public buildings, wholly in one occupation, and distant at least eight feet from the nearest street or alley, and at the least thirty feet from the nearest buildings, and from the ground of an adjoining owner. All buildings not exceeding in extent two hundred and sixteen thousand cubic feet, and not being public buildings, and distant at least thirty feet from the nearest street or alley, and at the least sixty feet from the nearest building and the ground of an adjoining owner. (We may here warn the reader that there is some doubt whether, supposing an edifice exempted on account of its site be erected not in accordance with the rules of the Act, and the owner sells the ground or erects another building within the prescribed limits of thirty feet, the first named, then irregular building, could not be treated as such and its owner be compelled to pull down or alter it in accordance with the prescribed rules.)

All party fence walls and greenhouses, so far as regards the necessary wood work of the sashes, doors, and frames.

Openings made into walls or flues for the purpose of inserting ventilating valves, of a superficial extent not greater than forty square inches, if such valves are not nearer than twelve inches to any timber or combustible material.

Building, when new.

7. 8. With these exceptions the Act applies to all new buildings; whenever mention is made of a building, it is deemed to imply a new building; and a building is deemed to be new whenever the enclosing walls have not been carried higher than the footings previously to the 1st January 1856, and others are deemed old buildings.

Alterations to old Buildings.

9. 10. 11. Any alterations affecting the construction of a building after the roof is covered in is subject to the regulation of the Act; and whenever any old Building is taken down to an extent exceeding one half, measured in cubic feet, the rebuilding of the new part must be in accordance with the Act and the old part if not so altered, pulled down and re-erected. If old buildings are separated by partitions and such are removed to the extent of one half, such buildings shall be deemed new and be divided in accordance with the Act.

Walls.

12. Walls are to be constructed as mentioned in the following Schedule.

FIRST SCHEDULE.

PRELIMINARY.

Structure.

Every Building is to be enclosed with brick, stone, or other incombustible substances, the foundation resting on the solid ground or concrete.

Walls.

The walls as above to be properly bonded and solidly put together with mortar or cement, no part overhanging the part below, and the return walls to be bonded together. Every stone wall in which the beds of masonry are not laid horizontally is to be one third more in thickness than hereafter prescribed; and the thickness named is to be in all cases the minimum thickness.

Height of Story, how measured.

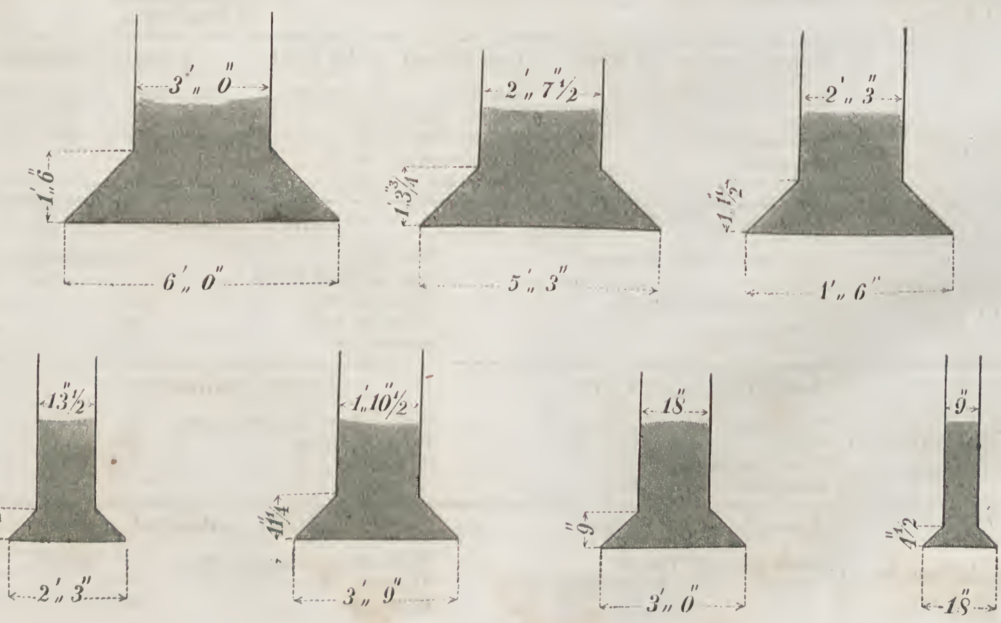
The height of every topmost story is to be measured from the level of its floor up to the under side of the tie of the roof, or up to half the vertical height of the rafters, when the roof has no tie; and the height of every other story is the clear height of such story *exclusive of the thickness of the floor.*

Height and Length of Walls, how measured.

The height of every external and party wall is measured from the base of the wall to the level of the top of the topmost story. (The base of the wall is measured from immediately above the footings.) Walls are deemed to be divided into distinct lengths by return walls, and the length of every wall is measured from the centre of one return wall to the centre of another; provided such return walls are external, party, or cross walls of the thickness hereinafter required, and bonded into the walls so deemed to be divided.

Footings of Walls.

The projection of the bottom of the footing of every wall on each side of the wall is to be at least equal to one half the thickness of the wall at its base; and the diminution of the footing of every wall is to be formed in regular offsets, and the height from the bottom of such footing to the base of the wall is to be *at least* equal to one half the thickness of the wall at its base. (These dimensions can be of course exactly adhered to in stone walls, but the practical bricklayer will at once perceive that, if brick footings have, as they invariably ought to have in good and sound construction, regular quarter brick offsets, their collective height will be greater than one half the thickness of the walls; and it will be best to have them thus.)



PART I.

RULES FOR THE WALLS OF DWELLING HOUSES.

Thickness of Walls.

The external and party walls of Dwelling Houses are to be made throughout the different stories of the thickness shown on the following Table, arranged according to the heights and lengths of the walls and calculated for walls up to one hundred feet in height, supposed to be built of bricks not less than eight and a half and not more than nine and a half inches in length, the height of the stories being subject to the conditions hereinafter given.

1.	2.	3.	4.
Height up to 100 Feet.	Length up to 45 Feet. Two Stories 21½ Inches, Three Stories 17½ „ Remainder 13 „	Length up to 80 Feet. Two Stories 26 Inches, Two Stories 21½ „ Two Stories 17½ „ Remainder 13 „	Length unlimited. One Story 30 Inches, Two Stories 26 „ Two Stories 21½ „ Two Stories 17½ „ Remainder 13 „
Height up to 90 Feet.	Length up to 45 Feet. Two Stories 21½ Inches, Two Stories 17½ „ Remainder 13 „	Length up to 70 Feet. One Story 26 Inches, Two Stories 21½ „ Two Stories 17½ „ Remainder 13 „	Length unlimited. One Story 30 Inches, Two Stories 26 „ One Story 21½ „ Two Stories 17½ „ Remainder 13 „
Height up to 80 Feet.	Length up to 40 Feet. One Story 21½ Inches, Two Stories 17½ „ Remainder 13 „	Length up to 60 Feet. Two Stories 21½ Inches, Two Stories 17½ „ Remainder 13 „	Length unlimited. One Story 26 Inches, Two Stories 21½ „ Two Stories 17½ „ Remainder 13 „
Height up to 70 Feet.	Length up to 40 Feet. Two Stories 17½ Inches, Remainder 13 „	Length up to 55 Feet. One Story 21½ Inches, Two Stories 17½ „ Remainder 13 „	Length unlimited. One Story 26 Inches, Two Stories 21½ „ One Story 17½ „ Remainder 13 „
Height up to 60 Feet.	Length up to 30 Feet. One Story 17½ Inches, Remainder 13 „	Length up to 50 Feet. Two Stories 17½ Inches, Remainder 13 „	Length unlimited. One Story 21½ Inches, Two Stories 17½ „ Remainder 13 „
Height up to 50 Feet.	Length up to 30 Feet. Wall below the Topmost Story 13 Inches, Topmost Story 8½ „ Remainder 8½ „	Length up to 45 Feet. One Story 17½ Inches, Rest of Wall below Topmost Story 13 „ Topmost Story 8½ „ Remainder 8½ „	Length unlimited. One Story 21½ Inches, One Story 17½ „ Remainder 13 „
Height up to 40 Feet.	Length up to 35 Feet. Wall below Two Topmost Stories 13 Ins., Two Topmost Stories 8½ „ Remainder 8½ „	Length unlimited. One Story . . . . 17½ Inches, Rest of Wall below Topmost Story . . . . 13 „ Topmost Story . . . . 8½ „ Remainder . . . . . . 8½ „	
Height up to 30 Feet.	Length up to 35 Feet. Wall below Two Topmost Stories 13 Ins., Two Topmost Stories 8½ „ Remainder 8½ „	Length unlimited. Wall below Topmost Story 13 Inches, Topmost Story . . . . 8½ „ Remainder . . . . . 8½ „	
Height up to 25 Feet.	Length up to 30 Feet. From Base to Top of Wall 8½ Inches.	Length unlimited. Wall below Topmost Story 13 Inches, Topmost Story . . . . 8½ „ Remainder . . . . . . 8½ „	

In using the Table the height of the Wall is to be reckoned on the first vertical column on the left hand of the Table, and the length of the wall on the corresponding horizontal column. The thickness of the wall on each story is given in inches and begins with the wall from the base upwards. Explanation of Table.

If any external or party wall, measured from centre to centre, is not more than twenty-five feet distant from any other external or party wall to which it is tied by the beams of any floors, other than the ground floor or the floor of any story formed in the roof, the length of such wall is not to be taken into consideration, and the thickness of the wall will be found in the second vertical column in the above table. Qualification in case of certain walls.

If any story exceeds in height sixteen times the thickness prescribed for the walls of such story, the thickness of each external and party wall throughout such story shall be increased to one sixteenth part of the height of the story; but any such additional thickness may be confined to piers properly distributed of which the collective widths amount to one-fourth part of the length of the wall. Stories exceeding a certain height.

No Story enclosed with walls less than thirteen inches thick shall be more than ten feet in height. Restriction in case of certain Stories.

The thickness of any walls of a dwelling house, if built of materials other than the bricks aforesaid, shall be deemed to be sufficient if of the thickness required in the Table, or of such less thickness as may be approved by the Metropolitan Board; but no diminution in thickness will be allowed for walls in which the beds of the masonry are not laid horizontally. (The thickness of these latter is prescribed at the commencement of this Schedule to be one-third greater than that given in the Table.) Thickness of Walls built otherwise than with bricks.

All Buildings, excepting public buildings and such buildings as are hereinafter described as of the warehouse class, are subject to the rules given for dwelling houses as regards the thickness of their walls. Buildings not belonging to the Public or Warehouse Classes.

PART II.

RULES FOR THE WALLS OF BUILDINGS OF THE WAREHOUSE CLASS.

The Warehouse Class comprises all Warehouses, Manufactories, Breweries and Distilleries. Definition of Warehouse Class.

The external and party walls are to be made at the base of the thickness shown in the following table, calculated for walls up to one hundred feet in height, and supposed to be built of bricks, not less than eight and a half inches and not more than nine and a half inches in length. Thickness of Walls at Base.

1.	2.	3.	4.
Height up to 100 Feet.	*Length up to 55 Feet.* Base 26 Inches.	*Length up to 70 Feet.* Base 30 Inches.	*Length unlimited.* Base 34 Inches.
Height up to 90 Feet.	*Length up to 60 Feet.* Base 26 Inches.	*Length up to 70 Feet.* Base 30 Inches.	*Length unlimited.* Base 34 Inches.
Height up to 80 Feet.	*Length up to 45 Feet.* Base $21\frac{1}{2}$ Inches.	*Length up to 60 Feet.* Base 26 Inches.	*Length unlimited.* Base 30 Inches.
Height up to 70 Feet.	*Length up to 30 Feet.* Base $17\frac{1}{2}$ Inches.	*Length up to 45 Feet.* Base $21\frac{1}{2}$ Inches.	*Length unlimited.* Base 26 Inches.
Height up to 60 Feet.	*Length up to 35 Feet.* Base $17\frac{1}{2}$ Inches.	*Length up to 50 Feet.* Base $21\frac{1}{2}$ Inches.	*Length unlimited.* Base 26 Inches.
Height up to 50 Feet.	*Length up to 40 Feet.* Base $17\frac{1}{2}$ Inches.	*Length up to 70 Feet.* Base $21\frac{1}{2}$ Inches.	*Length unlimited.* Base 26 Inches.
Height up to 40 Feet.	*Length up to 30 Feet.* Base 13 Inches.	*Length up to 60 Feet.* Base $17\frac{1}{2}$ Inches.	*Length unlimited.* Base $21\frac{1}{2}$ Inches.
Height up to 30 Feet.	*Length up to 45 Feet.* Base 13 Inches.	*Length unlimited.* Base $17\frac{1}{2}$ Inches.	
Height up to 25 Feet.	*Length unlimited.* Base 13 Inches.		

Explanation of Table.

The above Table is to be used in the same manner as that previously given, and is subject to the same qualifications and conditions respecting walls not more than twenty-five feet distant from each other.

Thickness at top of Walls and through Intermediate Space.

The thickness of the Walls of buildings of the Warehouse Class at the top and for sixteen feet below the top, is to be thirteen inches; and the intermediate parts of the wall between the base and such sixteen feet below the top, is to be built solid throughout the space between straight lines drawn on each side of the wall, and joining the thickness at the base to the thickness of sixteen feet below the top; nevertheless in walls not exceeding thirty feet in height, the walls of the topmost story may be eight and a half inches thick.

Stories above a certain Height.

If in any story of a Building of the Warehouse Class the thickness of the wall as determined in the Table is less than one-fourteenth part of the height of such story, the thickness of the wall is to be increased to one-fourteenth part of the height of the story; but such additional thickness may be confined to piers properly distributed, of which the collective widths amount to one-fourth part of the length of the wall.

Thickness of Walls of other materials than Brick.

The thickness of any wall of a building of the Warehouse Class, if built of materials other than the bricks as aforesaid, will be deemed sufficient if made of the thickness required in the Table, or of a less thickness, if approved by the Metropolitan Board; but no diminution will be allowed in walls of stone in which the beds are not horizontal. (These are prescribed one-third thicker.)

MISCELLANEOUS.

Note.

The following applies to Buildings of all Classes.

Cross Walls.

The thickness of a cross wall must be two thirds of the thickness required in the Tables for an external or party wall of the same dimensions, and belonging to the same class of buildings, but never less than eight and a half inches; and no wall subdividing any building shall be deemed to be a cross wall unless it is carried up to two-thirds of the height of the external or party walls, and unless the recesses and openings therein do not exceed one-half of the vertical section of the wall in each story. Every stone wall in which the beds of masonry are not laid horizontally must be one-third thicker than prescribed in the Table.

Buildings to which the rules are inapplicable.

Buildings to which the preceeding rules are inapplicable require the special sanction of the Metropolitan Board of Works.

RECESSES AND OPENINGS.

Recesses and Openings.

13. Recesses and Openings may be made in external walls provided that the backs of such recesses are not less than eight and a half inches thick, and that the area of such recesses and openings do not altogether exceed one-half of the total area of the wall in which they are made.

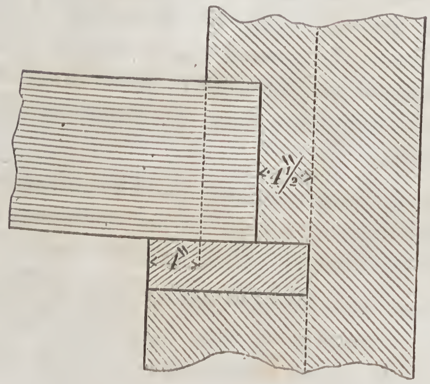
Recesses may be made in Party Walls, provided that the backs of such recesses are not less than thirteen inches thick, that their area does not altogether exceed one-half of the whole area of the story in which they are made, and that such recesses do not come within one foot of the inner face of the external walls, but no opening must be made in any party wall contrary to the rules of the act.

The word area, as used in this section, means the vertical area.

MISCELLANEOUS.

Timber in External Walls.

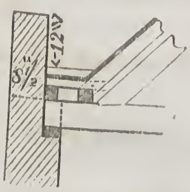
Loophole frames may be fixed within one inch and a half of the face of any external wall; but all other woodwork in external walls, except bressummers and story posts, frames of doors and windows of shops on ground stories, must be set back at least four inches from the external face of the wall.



Bressummers.

15. Every Bressummer must have a bearing in the direction of its length of four inches at the least, at each end, upon a sufficient pier of brick, or stone, or upon a timber or iron story post, fixed on a solid foundation, in addition to its bearing upon any party wall; and the ends of such bressummer must not be placed nearer to the centre line of the party wall than four and a half inches. No bond timber or wood plate is to be built into any party wall; the ends of any beam or joist bearing on such walls must be at least four and a half inches from the centre line.

Every bressummer, bearing upon a party wall, must be borne by a templet or corbel of stone or iron, tailed through at least half the thickness of such wall; and of the full breadth of the bressummer.

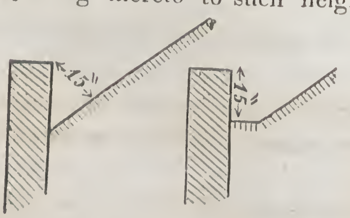


Parapets to External Walls.

16. If any gutter, formed in part or whole of incombustible materials, adjoins an external wall, then such wall must be carried up so as to form a parapet one foot at least above the highest part of such gutter; and the thickness of the parapet so carried up must be at least eight and a half inches, reckoned from the level of the underside of the gutter plate.

Height of Party Walls above Roof.

17. Every Party Wall must be carried up above the roof, flat or gutter of the highest building adjoining thereto to such height as will give a distance of fifteen inches, measured at right angles to the slope of the roof, or fifteen inches above the highest part of any flat or gutter as the case may be; and every party wall must be carried up above any turret, dormer, lantern light, or other erection of incombustible materials fixed upon the roof of any building within four feet from such party wall, and is to extend at least twelve inches higher and wider on each side than such erection; and every party wall is to be carried up above any part of any roof opposite thereto and within four feet from such party wall.

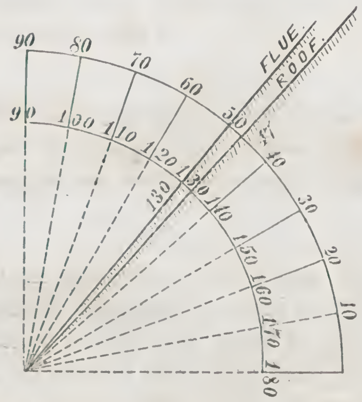


Chases in Party Walls.

18. No chase may be made in a party wall wider than fourteen inches, nor more than four and a half inches deep from the face of the wall, nor so as to leave less than eight and a half inches in thickness at the back; and no chase is to be made within seven feet of any other chase on the same side of the wall.

Roofs.

19. The flat, gutter and roof of every building, or any erection placed upon it, must be covered with slates, tiles, metal, or other incombustible materials, except the doors, door frames, windows and window frames of the erections upon it.



The plane of the surface of the roof of a warehouse or other building, used either wholly or partially for purposes of trade or manufacture, must not incline from the external or party walls upwards at a greater angle than forty-seven degrees. (The scope of this last paragraph, applying at it does to all buildings used even partially for purposes of trade, is exceedingly wide, and we do not gather from other parts of the act any limitation of it.)

Chimneys and Flues.

20. Chimneys, built on corbels of brick, stone or other incombustible material, may be introduced above the level of the ceiling of the ground story, but the work so corbelled out must not project more than the thickness of the wall; all other chimneys must be built on solid foundations, with footings similar to the footings of the walls.

Chimneys and flues, having proper doors of not less than six inches square, may be constructed at any angle, but in every other chimney or flue the angles must be formed of an obtuseness of not less than one hundred and thirty degrees and be properly rounded. (See woodcut above.)

An arch of brick or stone, or a bar of wrought iron, must be built over the opening of every chimney to support the breast thereof; and if the breast projects more than four inches and a half from the face of the wall and the jamb on either side is of less width than seventeen and a half inches, the abutments must be tied in at least eight and a half inches on either side.

The inside of every flue and the back or outside, unless forming part of the outer face of an external wall, must be rendered, pargeted, or lined with fire proof piping.

The jambs of every chimney must be at least eight and a half inches wide on each side of the opening thereof.

The breast of every chimney and the front, with the partition and back of every flue, must be at least four inches thick.

The back of every chimney opening, from the hearth up to the height of twelve inches above the mantel, must be at least eight and a half inches thick if in a party wall, or four and a half inches if otherwise.

The thickness of the upper side of every flue, when it is at an angle of less than forty five degrees, must be at least eight and a half inches.

Every chimney shaft must be carried up in brick or stone work all round, at least four inches thick, to a height of not less than three feet above the roof, flat or gutter adjoining, measured at the highest point in the line of junction.

The brick or stonework of any chimney shaft, excepting that of the furnace of any steam engine, brewery, distillery or manufactory, must not be built higher above any roof, flat or gutter adjoining than a height equal to six times the least width of such chimney shaft at the level of the highest point of junction, unless such chimney shaft is built with and bonded to another chimney shaft not in the same line with the first, or otherwise rendered secure. (Considerable latitude is thus left by "otherwise rendered secure"; iron tie rods would probably be deemed sufficient. The Act, too, regulates the construction of small chimney shafts, but omits to lay down rules for the larger ones attached to manufactories, the safety of which should most certainly have been guaranteed.)

Slabs and Hearths.

There must be laid before the opening of every chimney, level with the floor, a slab of stone, slate or other incombustible substance, at least twelve inches longer than the width of the

opening, and eighteen inches wide in front of the breast. And on every floor, except the lowest floor, such slab must be laid wholly on stone or iron bearers or brick trimmers, but on the lowest floor it may be bedded on the solid ground. The hearth or slab of every chimney must be bedded wholly on brick, stone, or other incombustible substance and must be solid for a thickness of seven inches at least beneath the upper surface of such hearth or slab.

No flue may be built against any party structure unless a withe is properly secured thereto, at least four inches thick. Flues against Party Walls.

No chimney breast or shaft built in connexion with any party wall is to be cut away unless the District Surveyor certifies that it can be done without injuriously affecting the stability of any building. Cutting Chimney Breasts.

No chimney shaft, jamb, breast or flue is to be cut into except for the purpose of repair, letting in, removing or altering pipes and smoke jacks, forming openings for soot doors, such doors to be fitted with iron doors and frames, or making openings for ventilation valves, such openings being not nearer than twelve inches to any incombustible substance.

No timber or woodwork is to be placed in any wall or chimney breast nearer than 12 inches to the inside of any flue or chimney opening; under any chimney opening within eighteen inches of the upper surface of the hearth; within two inches from the face of the work about any chimney or flue where the substance of such brick or stonework is less than eight and a half inches thick, unless the face is rendered; and no wood plugs are to be driven nearer than six inches of the inside of any flue or chimney opening, nor any iron fastenings nearer than two inches. Timber in and near Chimneys.

The following rules are to be observed with respect to close fires and pipes for conveying heated vapour and water. The floor under any oven or stove used for purposes of trade, and the floor around for the space of eighteen inches, is to be formed of incombustible materials. No pipe for hot air or steam is to be fixed on the face of any building next a public way nearer than six inches to any combustible material; for hot water nearer than three inches; for smoke nearer than nine inches; and for every offence a penalty of twenty pounds is incurred. Close Fires and Pipes for Vapoxr etc.

22. In every public building, and in every other containing more than one hundred and twenty five thousand cubic feet and used as a dwelling house for separate families, the floors of the lobbies, corridors, passages, and landings and also the flights of stairs are to be of stone, or other fire proof material, and carried on fire proof supports. Accesses and Stairs to Buildings.

23. Every habitable room, except rooms in the roof and cellars and underground rooms, must be in every part seven feet in height. Rooms in the roof must be at least seven feet in height throughout not less than one half the area of every room. Cellars and underground rooms must be as directed in the act for the better Local Management of the Metropolis. (The Section alluded to is given at the end). A penalty not exceeding twenty shillings for every day during which such rooms are inhabited, and they are deemed to be inhabited if any person passes the night in them, is the consequence of violating the rules laid down. Habitable Rooms.

24. Every party arch, and every arch or floor over any public way, or any passage leading to premises in other occupation, is to be formed of incombustible materials. If any arch of brick or stone is used, it must be, if the span does not exceed nine feet, of the thickness of four and a half inches at the least; but when the span exceeds nine feet, the thickness must be eight and a half inches at the least. If an arch or floor of iron or other incombustible material is used, it must be approved by the District Surveyor. Party Arches over Public Ways.

25. Every arch under any public way must be formed of incombustible materials. If an arch of brick or stone is used, it must, if the span does not exceed ten feet, be eight and a half inch thick at least; if the span does not exceed fifteen feet, it must be at least thirteen inches thick; Arches under Public Ways.

if the arch exceeds fifteen feet, or if iron or other incombustible material is used, it must be approved by the District Surveyor. (The fourth appendix to the Metropolis Local Management Act, Section 101, provides that "no vault, arch or cellar shall be made under any street without the consent of the vestry or district board.")

Projections.

26. Every coping, cornice, fascia, window dressing, portico, balcony verandah, balustrade, or any other projection or decoration, and also the eaves and cornices to any overhanging roof, except the cornices and decorations to the windows, fronts of shops, and the eaves and cornices to detached and semi-detached dwelling houses at least fifteen feet distant from any other building and from the ground of any adjoining owner, must, unless the Metropolitan Board otherwise permit, be of brick, tile, stone, artificial stone, slate, cement, or other fire proof material. (As the Editor of The Builder judiciously remarked, this "will put a difficulty in the way of the most natural sort of roof").

In streets or alleys of less width than thirty feet, any shop front may project beyond the external wall of the building for not more than five inches, and any cornice of any such shop front may project not more than thirteen inches; and in any street or alley of a width above thirty feet, any shop front may project not more than ten inches, and the cornice not more than eighteen inches. No part of the woodwork of any shop front must be fixed nearer than four and a half inches from the line of junction of the adjoining premises, unless a pier, or corbel of stone, brick or other fire proof material, four and a half inches wide at the least, is built or fixed next to such adjoining premises as high as such woodwork is fixed and projects an inch at least in front of the face.

The roof, flat, or gutter of any building, and every balcony, verandah, shop-front, or other projection, must be so arranged and constructed and so supplied with gutters and pipes as to prevent the water dropping upon any public way.

Except in so far as is permitted in this section in the case of shop fronts, and with the exception of water pipes and their appurtenances, copings, cornices, fascias, window dressings, and other like decorations, no projection from any building shall extend beyond the general line of fronts in the streets, except with the permission of the Metropolitan Board of Works.

Separation of Buildings and Limitation of Area.

27. Every building must be separated by external and party walls from an adjoining building. Separate sets of chambers or rooms tenanted by different persons must, if contained in a building exceeding three thousand six hundred square feet in area, be deemed separate buildings and be divided accordingly, so far as they adjoin vertically by party walls, and so far as they adjoin horizontally by party arches or fireproof floors. If any building in one occupation is divided into two or more tenements, each having a separate entrance and staircase, or a separate entrance from without, every such tenement is to be deemed a separate building. Every warehouse or other building, used either wholly or in part for purposes of trade, containing more than two hundred and sixteen thousand cubic feet, must be divided by party walls in such manner that the contents of each division does not exceed the above contents.

Rules as to uniting Buildings.

28. No buildings are to be united unless wholly in the same occupation; and none are to be united if when so they are in opposition to the rules of the Act. No opening may be made in any party walls dividing buildings, which, if taken together, would contain more than two hundred and sixteen thousand cubic feet, except under the following conditions; such opening not to exceed seven feet in width and eight feet in height, and to have the floor, jambs and head of brick, stone, or iron and be closed by two wrought iron doors, each one quarter inch thick in the panel, at a distance from each other of the full thickness of the wall, fitted to rebated frames without woodwork. Whenever any buildings which have been united cease to be in the same occupation, any openings made in the party walls dividing them must be stopped up with brick or stone work of the full thickness of and properly bonded with the wall.

29. Every building used as a dwelling house, unless all the rooms can be lighted from a street or alley adjoining, must have in the rear or side an open space exclusively belonging to it of the least extent of one hundred square feet. Yards to Dwelling Houses.

30. Every public building is to be constructed in a manner to be approved by the District Surveyor, or in the event of disagreement, by the Metropolitan Board, and save in so far as respects the rules of construction, every public building is to be subject to the provisions of the Act. Public Buildings.

DISTRICT SURVEYORS.

31. With the exemptions before mentioned, every building is to be subject to the supervision of the Surveyor to the District. District Surveyors.

32—37. These Sections relate to the power of the Metropolitan Board to alter districts, etc., and to the appointment of the District Surveyors, their Assistants, etc.

NOTICES TO DISTRICT SURVEYORS.

38. Two days before any building or any work upon any building is commenced, and also, if the progress of any such building or work is, after the commencement, suspended for any period exceeding three months, two days before such building or work is resumed, and also, if during the progress of any such building or work, the builder employed thereon is changed, then two days before any new builder enters upon the continuance of such work, it shall be the duty of the builder engaged to give to the District Surveyor notice in writing, stating the situation, area, height and intended use of the building about to be commenced, or on which any work is to be done, and the number of such buildings, if more than one, and also the particulars of any such proposed work, stating his own name and address, but any works upon the same building that are in progress at the same time may be included in one notice. Notices to District Surveyors.

39—43. The District Surveyor will survey the works from time to time, and every notice will be deemed evidence against the builder of the nature of the works. The penalty for neglecting to give notice, for proceeding with the works before two days, for refusing to admit the District Surveyor, or to afford him reasonable assistance, or for violating any of the above rules, is, in each case, not to exceed twenty pounds, recoverable before a justice of the peace. Penalties, etc.

44. Any work required to be done immediately, or before notice can be given, may be executed on condition, that before the expiration of twenty-four hours after such work has been begun, notice is given to the District Surveyor. Cases of Emergency.

PROCEEDINGS BY DISTRICT SURVEYOR IN CASE OF IRREGULARITY.

45—48. If in erecting or doing any work on any building, anything is done, or omitted to be done, contrary to the rules of the Act, in cases where due notice has not been given, or if the works are too far advanced for the Surveyor to ascertain irregularities, in every such case the District Surveyor shall give to the builder engaged notice in writing, requiring such builder, within forty-eight hours from the date of the notice, to cause such irregularity to be amended, or to cause such portion of the works as prevents the ascertainment of the irregularity to be cut into, laid open, or pulled down. And if the builder does not comply within forty-eight hours, a summons from the justice of the peace will be issued commanding the builder to comply with the notice within a time named. On non-compliance with such order, a penalty is incurred not exceeding twenty pounds a day during every day of the continuance of such non-compliance Irregularities and Penalties.

and in addition thereto the District Surveyor may execute the works in compliance with the notice and recover the expenses from the builder or owner of the premises; and if the owner cannot be found, the District Surveyor may sell the building and apply the proceeds. Any workman employed on any building who shall wilfully, and without the consent of the person causing the work to be done, do anything contrary to the rules of the Act, shall, for each offence, incur a penalty not exceeding fifty shillings.

FEES OF DISTRICT SURVEYOR.

Fees of District Surveyor,

49. The Fees of the District Surveyors are to be as in the Second Schedule, or such other fees not exceeding the amount specified as may be directed by the Metropolitan Board of Works, but one fee only is chargeable with respect to works done on any building in pursuance of the provisions hereinbefore contained included in one notice.

SECOND SCHEDULE.

PART I.

FEES FOR NEW BUILDINGS.

	s.	d.
For every Building not exceeding four hundred square feet in area and not more than two stories in height	30	0
For every additional story	5	0
For every additional square of one hundred feet or fraction of such square,	2	6
But no fee shall exceed ten pounds.		
And for every building not exceeding four hundred square feet in area, and of one story only in height the fees shall be	15	0

FEES FOR ADDITIONS AND ALTERATIONS.

For every addition and alteration made to any building after the roof thereof has been covered in, the fee shall be half of that charged in the case of a new building.		
For inspecting the arches or stone floors over or under public ways .	10	0
For inspecting the formation of openings in party walls	10	0
For inspecting dangerous structures by direction of the Commissioners of police or sewers	20	0

NB. In this Schedule "Area" includes the area of any attached building.

Special Fees.

50. In cases where no fee is specified, the Metropolitan Board of Works will settle the amount.

51. At the expiration of the following periods; one month after the roof of any building is covered in, or fourteen days after the completion of works placed unter the supervision of the District Surveyor, he is entitled to his fees. On refusal, they may be recovered before a justice of the peace, on proof of the bill being delivered in a registered letter, sent to the last known residence of the builder, owner or occupier. Periods for Payment of Fees.

52—54. These Sections relate to the returns to be made by the District Surveyors to the Metropolitan Board of Works. Returns of District Surveyors.

POWER OF METROPOLITAN BOARD OF WORKS.

55. The Metropolitan Board may alter the rules for the thickness of walls. Alteration of Rules.

56. Plans and particulars of iron and other buildings to which the rules of the Act are inapplicable must be submitted for the approval of the Board; but it cannot authorize the erection of any building for purposes of trade or manufacture of greater dimensions than two hundred and sixteen thousand cubic feet, unless it is divided by party walls. Buildings to which Rules are inapplicable.

57—68. Relate to the modes of procedure, power to appoint and remunerate officers, and provide that all expenses of applications are to be borne by the applicant.

PART II.
DANGEROUS STRUCTURES.

69—81. Any building or part of a building reported to be in a dangerous state will be surveyed by a District or other Surveyor appointed by the Commissioners of Sewers in the City, or, if elsewhere, the Commissioners of Police; and if the report be confirmed, they will cause the same to be shored up, a hoard put round, and notice to be given to the owner or occupier requiring him immediately to take down, secure, or repair the same. If the owner or occupier does not comply so soon as the case requires, complaint will be made before a justice of the peace, and an order issued to make the requisite alterations within a certain time; and if they are not then done, the Commissioners will execute the works and require the payment of all expenses from the owner, without prejudice to his right to recover the same from any lessee or other person liable to the expenses of repairs. If the owner cannot be found, or refuses or neglects to pay the aforesaid expenses, the Commissioners, after giving three months notice of their intention by posting a notice on a conspicuous part of the structure, may sell it, and, after deducting the expenses, will pay the surplus to the owner; and if no demand is made for it, the same will be paid into the Bank of England to the credit of the owner, to be paid to him on proving his claim. Dangerous Structures.

In cases where a structure is certified to be dangerous, a justice of the peace may, on the application of the Commissioners, order a peace-officer to remove the inmates; and if they have no other abode, he may require them to be received into the Workhouse.

PART III.

PARTY STRUCTURES.

Building and Adjoining Owners.

82. The owner of the premises separated by and adjoining a party structure, who is desirous of executing any work in respect to such party structure, is called the building owner, and the owner of the other premises, the adjoining owner.

Rights of Building Owner.

83. The Building owner has the following rights:

A right to make good or to rebuild any party structure that is so far defective as to render either desirable. A right to pull down any partitions, intermixed rooms and stories belonging to different owners, arches or communications against the rules of the Act, and to rebuild the same in conformity with it. A right to raise any party structure, or to pull down the same, if of insufficient strength for proposed works, or to cut into any party structure, or to cut away any projecting work from a party wall in order to erect an external wall against it, on condition of making good all damage to adjoining premises, and of carrying to the requisite height all works belonging thereto, and adhering strictly to the rules of the Act; but the above rights are subject to the qualification that any building executed previously to the time of this Act coming into operation is to be deemed conformable with it, if it is so with the provisions of the Act of the fourteenth George III., chapter seventy-eight, and that of the eighth year of her present Majesty, chapter eighty-four.

Rights of Adjoining Owner.

84. The adjoining owner may require the building owner to build on the party structure flues, piers etc. for his convenience if not injurious to the former or causing unnecessary delay in the works.

Rules as to Rights.

85. Except with the consent of the adjoining owner or in the case of dangerous structures, no building owner may execute works before giving three months notice to the former, either by delivering it personally, or sending it in a registered letter to the last known address of the adjoining owner, the notice being in writing, and stating the nature of the works; and the right is not to be exercised at a time to cause unnecessary inconvenience. The adjoining owner may then, within one month, specify and require such works as he may desire to be executed on the party structure; and if either owner do not, within fourteen days from the delivery of the notice, express his consent thereto, he is to be considered as dissenting therefrom, and a difference is deemed to have arisen. Unless then both parties concur in the appointment of one surveyor, each shall appoint a surveyor, and the two surveyors shall elect a third, and the decision of any two shall decide all points of difference; but the works shall not commence until the expiration of the three months aforesaid. Either of the parties may appeal from the award of the surveyors to the County Court within fourteen days. If either party fails to appoint a surveyor within ten days of the notice to do so, the other party may make the appointment, and the surveyors are to determine who is to pay the costs. If the applicant from such award is unwilling to have the matter decided by the County Court, and proves that, if it is decided against him, he will be liable to pay a sum, exclusive of costs, exceeding fifty pounds, and give approved security to prosecute his appeal, he may bring an action in one of the superior courts at Westminster.

Building owners' right to enter Premises.

86. When a Building owner is entitled to execute works, it is lawful for his agents to enter the premises at all proper hours, remove furniture, etc., and if the premises are closed, to break open the doors, if accompanied by a peace officer. Any person obstructing the workmen or damaging wilfully the work is subject to a penalty not exceeding ten pounds.

87. Any adjoining owner may require the Building owner to give security for the payment of costs payable by the latter. Security to be given by Building owner.

88. The expenses are to be borne jointly by the building and adjoining owner; when any party structure is so defective as to require to be either repaired or rebuilt; when any partition, intermixed rooms or stories, arches or communications against the Act, are pulled down and rebuilt in accordance with it and the rights vested in any building owner. The expenses are to be borne wholly by the building owner; when he raises any party structure or external wall and carries up in consequence the flues etc. of the adjoining owner; when any sound party structure is pulled down and rebuilt, or cut into, or any projecting work is cut away, and all damage must be made good. Payment of Expenses.

89. When part of the expenses are borne by an adjoining owner, the account must be delivered within one month of the completion of the works; the value of old materials being deducted, and the prices being fair average rates. Account of Expenses.

90. 91. 92. The adjoining owner may appeal against the account within one month of its delivery, and the difference shall be determined in the manner before specified. If he does not appeal within the time, the amount may be recovered as a debt. Until such contribution is paid, the building owner is possessed of the sole property of the structure. The adjoining owner is liable for all expenses of works executed at his desire, such sum to be recovered as a debt. Appeal.

94. A building owner, failing to make good within a reasonable time any damage for which he is liable, is subject to a penalty not exceeding twenty pounds for each day during which such failure continues. Penalty on Building owner.

95. 96. When any consent is required for works from persons under disability, it may be given, by a husband on behalf of his wife, by a trustee on behalf of his trust, by a guardian or committee on behalf of an infant, idiot, or lunatic. If there is no owner capable of giving consent, or cannot be found, the judge of the County Court has power to do so. Consent how given.

PART IV.
MISCELLANEOUS PROVISIONS.

97. The following rules are to be observed where it is declared that expenses are to be borne by the owners of premises. The owner immediately entitled in possession, or the occupier, is in the first instance to pay the expenses, with the provision that no occupier is liable to pay any sum exceeding that rent hereafter accruing to him during his occupancy. Every owner is liable to contribute in proportion to his interest in the premises; and if any difference arises, it is to be decided by arbitration in conformity with the Companies Clauses Consolidation Act. If some owners cannot be found, the deficiency is to be divided among those that can be found. Any occupier may deduct the amount paid from rent payable by him; and any owner who has paid more than his proportion may deduct the difference from rent payable by him to any other owner of the same premises. If any default is made by owners or occupiers, then, in addition to the other remedies provided, such monies may be recovered as a debt in due course of law. Payments by owners.

98. *In cases not provided for, the following rules are to be observed in the case of notices and summons. A notice summons or order, may be served personally on any builder, owner, or* Service of Notice.

occupier on leaving the same or addressing it in a registered letter to his last known residence, or posting the same on a conspicuous part of the premises if no other course is open, and if the name of the party is not known, it is not necessary to insert it.

County Courts, etc. 99. 108. These Sections relate to the forms of proceedings in County and other Courts, recovery of penalties, notices of action against District Surveyors etc.

PART V.
REPEAL OF FORMER ACTS AND TEMPORARY PROVISIONS.

Repeal of Acts. 109. The Act 8, and 9, Victoria, c. 84 is repealed, except sections 54, to 63, (relating to dangerous and noxious businesses), and also the Act 9, and 10, c. 5, subject to certain provisions stated. The Act 14, George IIII. c. 78, sections 74, to 86, (relating to fire engines etc.) continues in force. (The Sections of the Companies Clauses Consolidation Act applying to the present Building Act, are 4. 5. 128. 129. 130. 132. 133. 134.)

Contracts previous to Act. 110. Contracts made previous to the passing of the Act are to be carried out as if the Act were in force at the time, and disputes are to be decided by the County Court.

Liabilites between Landlord and Tenant. 111. Nothing in the Act is to affect the rights and liabilities between Landlord and Tenant in any contract between them.

Iron Buildings. Iron buildings in progress before passing of Act may have the attention of the Commissioners of Works drawn to them by any person interested, and they will signify their approval upon being satisfied of the stability of such building.

Compensation to Officers. 113. 114. Relate to the compensation of the Officers under the old Act.

THE METROPOLITAN LOCAL MANAGEMENT ACT.

We append an abstract of a few sections of this Act, which are of equal importance to builders to any of those of the Building Act.

Drains. 73. This section provides that if any house built before or after the commencement of the Act, situate within any of the district subject to it, be not sufficiently drained, and a sewer of sufficient size is within one hundred feet of it, it is lawful for the vestry or local board to require the execution of drains and every requisite, and on neglect, to execute the same and recover the expenses from the owner.

74. If a group of buildings can be drained more economically and advantageously in combination than separately and a sewer exists within one hundred feet of such houses, whether contiguous, detached or semi-detached, the board may order them to be drained by a combined operation.

Notice to be given of new buildings. 76. Before beginning to dig the foundations of a house, or rebuild any house, and before making any drain, seven days' notice must be given to the board; and the foundations must be laid at

such a level as to permit the drainage and all the works connected with them, as the board shall direct; these orders will be notified by the board within seven days of the receipt of the notice: and if, in default of such notice, the works are executed and the water supply begun, the board will cause the same to be demolished, the works to be executed, and recover the expenses from the owner.

77. Any person constructing drains not in accordance with the directions of the board, is subject to a penalty of fifty pounds. Penalty.

78. 79. The board may make house drains at the expense of owners on agreement with them. Drains.

81. It is not lawful to erect any house without a proper water closet (or privy, if there are no sewers) and ash pit, under a penalty of twenty pounds. Water Closets.

A penalty of ten pounds is consequent on improperly making, stopping up, or injuring drains, sewers, water closets, cesspools, water supplies etc. The board may demolish, alter, and reinstate improper works and charge the expenses. Penalty.

101. No vaults, cellars and arches may be made under any street without the consent of the board; and if not repaired on requisition, the board may repair and charge the expenses. Vaults and Cellars.

103. Underground rooms, occupied separately as dwellings at or before the passing of the Act, may continue to be so, if there be an area of not less than three feet wide in every part, from six inches below the floor of such room or cellar to the surface or level of the ground adjoining to the front, back, or external side thereof, and extending the full length of such side; if such area, to the extent of at least five feet long and two feet six inches wide, be in front of the window of such room or cellar and be open or covered only with open iron gratings; if there be in every such room an open fire place and flue; and if there be a window opening of at least nine feet super glazed, with at least half made to open. No such room unoccupied at the passing of the Act shall be occupied unless it is in every part seven feet in height; unless it is at least one foot high above the footing of the adjoining street; unless there extends along the entire frontage of the room, from six inches below the level of the floor up to the surface of the footing, an open area at least three feet wide in every part; unless the same be effectually drained and secured from the rise of effluvia; unless there be appurtenant the use of a water closet, privy and ash pit; with proper coverings etc., unless there be a fire place, flue and windows as above described. There may be placed steps necessary for access to such rooms, and also for access to the building above, provided such steps be not over or across the window. Every room in which a person passes the night is deemed to be inhabited, and the penalty for violating the above rules is not to exceed twenty shillings for every day during which it is occupied. Underground dwellings.

121. 122. 123. Permission must be obtained to erect hoards and enclosures. Whenever the footway is obstructed, proper pathways with rails are to be formed, maintained and be well lighted if necessary; the penalty for not doing so is five pounds for each offence, and forty shillings during its continuance for every day. Hoards.

If a hoard is erected without a license, continued beyond the time stated, or not kept in repair, a penalty of five pounds, and forty shillings for every day during the continuance of the offence is the consequence: the hoard may be pulled down by the board and all expenses recovered.

143. Relates to the illegality of erecting buildings beyond the line of streets without permission. Line of Streets.

204. Relates to the illegality of erecting buildings over sewers without permission. Building over Sewer.

211. Relates to the power of appeal to Metropolitan Board of Works against acts of local boards. Appeal.

217. 218. 219. Relate to the payment of costs which the owner of any premises may be liable to pay from any person who occupies them; the occupier to deduct all sums which he pays from the rent, but without affecting any contract between the owner and occupier. Costs.

DESIGNS FOR CEMETERY CHAPELS.

The widely extended demand caused by a late Act of Parliament for Cemetery Buildings and the fact that there is not, so far as we are aware, a work on the subject, and certainly not one comprising working details specifications and estimates, render it obvious that the introduction of them in this Serial will be of peculiar value to many connected with building operations. We have taken great pains to arrive at the usual requirements and to obtain correct information to render the designs given of really practical value. They are also submitted as ornamental erections with that characteristic decoration which is usually required. As will be at once perceived, the working details are applicable to a wide range of purposes, in addition to those by which they have been more immediately suggested; and, from the scale to which they are drawn, will, we trust, be found of universal utility to the practical operative, who will of course vary them more or less in their adaptation to different requirements. The specification for the designs under description will be fully sufficient to carry out the works and is as ample as would be given for their erection. Correct estimates are obviously extremely difficult to obtain, owing to ever varying prices of labour and materials, the facility with which they can be obtained, and the impossibility of naming a sum which shall apply with perfect correctness to all parts of the country. Those given will be found as near the average as possible, taking all circumstances into consideration. In this instance, from so many details being given, in addition to the specification, any builder will be enabled to furnish an accurate estimate; and if several tender for a building, it is well known how widely divergent the totals very commonly are found. The architecture of Cemetery Chapels is recommended by the government to be of an ecclesiastical character, distinctive of the object of the buildings, and the internal walls and flooring to be of impervious materials, admitting of being easily washed and cleansed; glazed encaustic tiles being suggested as cheap, and ornamental. The ventilation and lighting too is of great importance, and particulars of the former will be found in the article under that heading. Cemeteries, we may here remark, should not be placed where buildings are likely to rise, or near wells and sources of water, and there must be a natural fall in the ground to secure drainage and dryness of soil to the depth of at least seven or eight feet. Dry, sandy soils and gravels are the best, and dense clays, bog earth and stony ground the worst. Particulars of drainage will be found in the article treating on drainage generally. Great attention should be paid to the formation of roads and pathways, and there should be a proper surface drainage of them by means of gutters and trapped gully shoots, connected with the drains below. The surface covering will be regulated by the district and ought to be always of hard materials. The fencing around should be open; as high walls are costly and impede ventilation and points of view. Grass is the best species of vegetation, and trees which do not cover much space and cast great shade are preferable; if placed along the pathways, not too closely planted, they are desirable as affording shelter. Two-thirds of the ground are often appropriated to the Church of England and the

chapels planned separately. In the present designs we have connected them by a central covered archway and porches. As the chapels are small, they have a diminutive appearance placed in the midst of extensive grounds; a defect which is obviated by joining them together as in the present instance and obtaining, in addition to the extra importance given to the structures, the convenience of a covered entrance and arcades, forming porches uniting altogether in an harmonious group. The chapels will probably be placed in the centre of the grounds with the division line between the consecrated and unconsecrated ground in the centre of the archway; they are each twenty two feet by forty, with robing rooms attached to them. A belfry is connected with the episcopal chapel, and W. C. with the porches of each. The small rooms marked R. R. on the plan will be found useful for many purposes, and may be used as reception rooms for the coffins of poor persons previous to burial. When, as is often the case with the poor, one room serves for all purposes, the injury to the health of the living from the retention of the dead must be obvious, and in German cities reception houses are very common. The materials to be used in the construction of the buildings are fully described in the following specification, and will be found applicable to most districts. Stone is decidedly the most satisfactory material for the walls, and all external cement work should be banished from structures intended for duration, quite independently of other forcible objections to its introduction. The timber used will probably be oak or fir, the former of course preferable for the roofs, joists, and benches, but more expensive than the latter: it seems to us however that in these structures especially considerations of duration should outweigh little economies. The benches are shown open instead of inclosed, as the former is by far preferable. A pulpit is placed in the dissenters', and open desks in the episcopal chapel; the arcade behind is to be appropriated for inscriptions. The archway and porches are vaulted; and the chapels have open timber roofs, preferable for many reasons, and allowing of the utmost amount of interior height. The flooring is described boarded, as decidedly most conducive to comfort and warmth.

SPECIFICATION.

The ground is to be excavated to the depth of three feet under the buildings, with the exception of the archway, and to be levelled and well rammed as the works are brought up, the superfluous earth being laid in such manner as shall be directed. Excavator.

If concrete is required, it is to be tipped over from the barrow at the lowest level and placed in layers, nine inches in thickness, twice the breadth of the lowest course of footings, and eighteen inches in depth. The whole surface of the ground enclosed is also to have a layer nine inches in thickness. It is to be composed of four measures of broken stones, passed through a sieve of an inch mesh, two of sand and one lime; and if the trenches are made wider than necessary, they are to be filled in with concrete and not with earth. The lime and sand are to be converted into mortar before adding the stones.

The foundations are to be executed with hard, well burnt, grey stock bricks up to nine inches from the ground level, the lowermost to consist of a double course, and the two above single courses, the projections on each side not being more or less than a quarter brick. Build on two sides of Chapels and Robing Rooms $4^1/_2''$ sleeper walls and $9''$ sleepers down the centres of chapels, to steps at east ends, to carry framework of catafalques, and to fireplaces in Robing Rooms; all to have a double course of footings. The brickwork is to be laid in English bond, whole bricks only to the footings, and nothing less than half bricks anywhere. The Archway, Entrance Porches and Belfry are to be vaulted in brickwork, and the Bricklayer is to co-operate with the Mason in fixing stone ribs, $9''$ in thickness to the Archway and $6''$ to the Porches. Bricklayer.

The vaulting to the Porches and Belfry is to be in $4^1/_2''$ work and that to the archway 9 inches; the spandrils of the latter are to be filled up with brickwork so as to form a level surface at the top.

The mortar is to be composed of three measures of grey stone lime and one of river sand, both entirely free from impurities. The lime is to be reduced to a paste before being mixed with the sand, and no more water is to be used than is necessary to cause it to fall into a powder. The sand for the rag stone walls is to be coarse unscreened, and they are to be pointed on the outside with blue lias lime and sand in the above proportions. The mortar for Bath stone work is to have sand of a fine quality. The lime is to be kept dry, and no more mortar is to be made at one time than can be used during the day.

The drains are to be 5 inch stoneware tubular drains, in two feet lengths, jointed with well tempered clay, properly trapped, and with all necessary elbows, junctions etc. The Contractor is to state a sum per foot for which he will provide and lay them; and is also to form a tank and cesspool, if required, at a price to be determined.

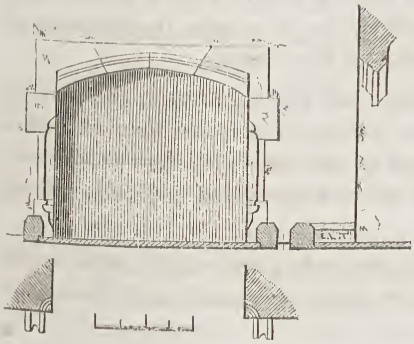
Mason. The several kinds of stone required are to be each the most durable and the best quality of their several kinds, and perfectly free from vents, sand holes, salts and other defects.

The sizes of the stones are shown on the drawings, and where they are not indicated, are to be got out as shall be directed; all the stones are to lay on the bed in which they are found in the quarry and are to be marked for that purpose; and all the beds, joints, arch and water joints, mouldings, sinkings, throatings, joggles, etc., are to be executed in the soundest and most workmanlike manner and put together with all necessary bond stones, cramps, plugs and joggles, whether shown and described in individual instances or not, so as to leave the works complete and perfect.

The main walls are to be of Kentish Rag or other sandstone, coursed indiscriminately, that is, with two or more courses to every quoin, and constructed with blocks of the greatest possible length and depth. The top and bottom surfaces are to be scappled tolerably parallel; the sides need not be so, but all sharp angles are to be knocked away. Each course is to consist of stones of the same height, for which purpose they are to be guaged and dressed with the hammer and assorted in heaps. The faces are to be axed or hammer dressed.

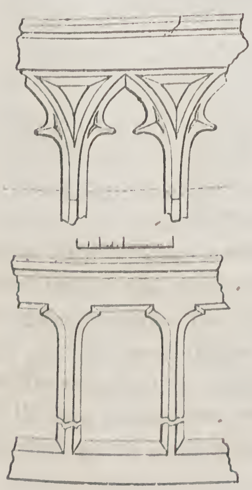
Discharging arches are to be turned wherever needful and there is space over the doors and windows, with stones not less than 12 inches in height; each arch having proper arched joints well bedded in mortar.

The quoins, jambs, heads and sills to windows, door jambs, and arches, strings, copings, ribs to vaulting and the carving and dressings generally, are to be executed in Bath or other limestone determined upon. The quoins at the angles of the chapel and to their buttresses are to be finished with a neatly picked face and drafted angle, the rest of the Bath stone work being worked fair and carefully rubbed. The sills of windows are to be in as large stones as can be procured, properly weathered, the joints made thoroughly water tight, and holes drilled for the escape of the condensed moisture from the glass. The mullions are to be grooved for the insertion of lead lights, and saddle bars to be let in for securing them, after which they are to be carefully pointed, together with the lead lights, with white lead and oil; they are to be $^3/_4''$ square, $1^1/_2''$ longer than openings, and of the distance apart shown; the lead lights are to be secured to them with copper wire. The tracery to the windows is to be carefully formed, together with the mullions, and slate dowels used at the joints, which are to be neatly set and pointed with fine mortar. The strings, where not otherwise shown, are to tail into the wall their full projection from the face, but never less than 4 inches. All the carving is to be executed by a superior carver to be approved by the architect, and models of the two angels are to be first submitted before proceeding to execute them in stone. Flues, nine inches square, are to be formed from the two fireplaces in the Robing rooms, which are to have Caen Stone rubbed Chimney pieces



and fenders, $4'' \times 3''$, chamfered both sides as in the margin, put together and fixed with every requisite, slabs, etc. complete. The chimney shaft is to be as shown, with picked Bath stone dressings, splayed top, with opening on one side only from roof. The coping to gables is to be $5''$ thick, as on Plate 5, moulded, throated and joggled together, with carved knee stones at ends of coping, tied in with galvanized iron cramps, $1\frac{1}{4}'' \times \frac{5}{8}''$, turned up and down at ends. Solid saddle stones are to be fixed at the top of gables, with cross, $7''$ thick, over west end of Episcopal chapel, in accordance with the detail drawing on Plate 9. The Belfry turret is to be executed with great care, as shown on Plate 8, with all necessary cramps at the angles, not less than $\frac{5}{8}'' \times \frac{3}{8}''$ and $6''$ long, and dowels $3'' \times 1''$, all of wrought iron galvanized. Inch $\frac{1}{2}$ galvanized iron bolts, nuts, screws, and washers where shown, with cross pieces as indicated, $1\frac{1}{2}'' \times \frac{3}{4}''$, turned down at ends to tie in stonework. The sloping side may be jointed in either mode shown, and the carved finial and mouldings are to be in accordance with the enlarged details. Particular care is to be paid to the formation of neat, close, workmanlike joints, which are to be filled in with fine mortar. Grooves are to be cut and the mason is to fix sawn slate louvres, $1\frac{1}{4}$ inch thick, of the size and in the manner indicated. Plates 5, and 7, contain details of the windows and arcade; the large windows to Dissenters' Chapel to have jambs precisely similar to that on Plate 7, the tracery only being varied. Plate 10, has details of the doors to Belfry and Robing Rooms, also the outer door to chapels; the jambs of the inner door to chapels are to be similar to the outer only rather smaller. The doors marked *R. R.* are to have simply splayed jambs on the face with lintels as shown.

Thirty openings are to be left in the walls, eighteen inches above the ground level where will be pointed out, and these are to be filled in with galvanized iron gratings, $9'' \times 3''$, of a pattern to be chosen of the P. C. value of six pence each; these openings must be left perfectly clear and free from rubbish.



The Entrance Porches, W. C., and rooms marked *R. R.* are to be paved with $3''$ rubbed York paving in parallel courses, laid on the concrete and bedded and pointed in mortar. Put also York steps to outer entrances to Porches $3''$ longer than the openings, of their full depth and $5''$ high, and similar steps are to be provided to the two other doors under archway all back rebated for paving. The arcades or *reredos* at the east end of chapels are to be as in the margin, of Caen stone rubbed. They are to be built up with the wall, no part tailing in to it less than $4''$, with bonders tailing $9''$ in the proportion of at least $\frac{1}{16}$ of the face.

CARPENTER AND JOINER. The whole of the timber used must be such as can be proved to have been cut down at least two years from the time of signing the contract.

The oak is to be of English growth, perfectly sound and free from any defects. No American or Scotch fir is to be used, but the yellow fir to be the best description of Swede, of hearty quality, free from sap, shakes, wainey edges, large, loose and dead knots. The deals to be the best Stockholm yellows, sound and clean.

A small wood building about 12 feet square is to be erected for the exclusive use of the clerk of the works; it is to have a fireplace, glazed sash windows, ledged shutters, and desk the whole

length of room, with lock and drawers. The room is to be floored and to have a ledged door with lock and fastenings complete. The materials of this building are to remain the property of the contractor, and are to be removed by him on the completion of the chapels.

The whole of the timbers are to be got out to the scantlings and put together in the manner shown on the drawings and described herein. No joists or rafters to be more than 12 inches apart; and no timber is to be notched, cogged down, mortised or cut otherwise than is directed, or placed within 9 inches of the flues, and fir bricks or plugs are to be provided and built or fixed into the walls to attach the skirting.

The carpenter is to provide and fix all centring and cradling to arches and vaults, with proper ribs, battening, wedges, beams, struts etc. and they are not to be eased or struck until directed by the architect.

The flooring joists to the Chapels are to be of oak, 6″ × 3″, resting on oak plates 4″ × 3″. The Robing Rooms and Belfry are to have oak joists 4″ × 3″ and plates 3″ × 3″. The flooring is to be all inch $^1/_4$ yellow deal, laid straight joint with edges nailed; it is to be raised in two steps at the east end of chapels, with rebated risers and grooved and rounded nosings. Put all round walls, wherever boarded floors occur, inch chamfered skirting 9 inches high, securely fixed to the walls, and with the top rebated to receive plaster and the bottom also to a groove in boarding.

The roofs are to be framed and put together in the manner shown, the purlins, plates and rafters to be in as long lengths as can be obtained, and the ends and joinings of all plates to be well lapped and spiked, or pinned and wedged together with oak or elm wedges. The curved ribs may be put together in thicknesses, well bolted; and the rafters to roofs over Chapels are to have rafter feet as shown on Plate 9. The plates are to be bedded in mortar even and solid on the walls. All the roof timbers are to be jack planed on the under sides, worked neat wherever visible, and the under arrises stop chamfered. The roof over Episcopal Chapel is shown in detail on Plate 9. The scantlings of the timbers are to be as follow;—

Arched ribs	7″ × 7″
Principals	7 × 7
Collars	7 × 7
King posts	7 × 7
Arched struts	6 × 5
Rafters	$4^1/_2$ × $2^1/_2$
Purlins	8 × 5
Ridge piece	10 × 5
Uprights to Principals	5 × $4^1/_2$
Plates moulded, framed and lapped	6 × 5

Upright Inch $^1/_2$ boarding is to be scribed and fitted where shown between rafters, with spaces 9″ × 3″ cut through where will be pointed out. The spaces for ventilation both above and below are to be covered with perforated zinc. Three modes of framing the ribs and collar together are shown, any of which may be adopted. The strap is to be of wrought iron 2″ × $^1/_2$″, with $^1/_2$″ bolts. If the collar is secured as at C., a screw bolt $^3/_4$″ diameter is to be introduced. An inch bolt is to pass through, feet of ribs, principal and upright where indicated, and all the bolts are to have proper screws, nuts and washers complete. The battening is to be as described under Slater.

The roof over Dissenters' Chapel is to have plates, purlins, uprights at feet of principals, with screw bolts and ridge piece, rafters and boarding, similar to the roof above described; in other respects it is to be framed as shown on the Longitudinal Section, with Principals, Collars, and King Posts 8″ × 6″, arched Struts 6″ × 4″ tenoned into King and Principal. Connect King

post, tenoned into Collar with the latter by means of a wrought iron strap, $2'' \times \frac{1}{2}''$, with $\frac{1}{2}''$ screw bolts; and halve the Collar with Principals, connecting them with a similar bolt.

The roof over the wings, between Archway and Chapels, is to have plates $4'' \times 3''$, rafters $4'' \times 2\frac{1}{2}''$, ridge $7'' \times 1\frac{1}{2}''$, and gutter bearers $3'' \times 1\frac{1}{2}''$, as shown on Plate 5.

Inch yellow deal gutter boards, edges shot and laid with a fair surface to a fall of 2″ in 10 feet, 2″ drips, and cesspools, 3″ deep and 12″ in width and depth.

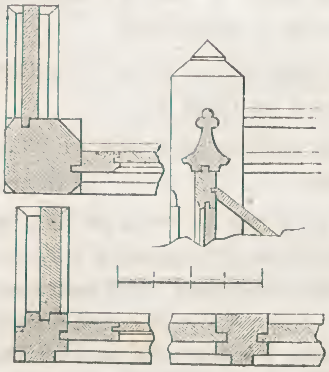
The flat over archway is to have inch boarding, edges shot, laid to a fall of 3″ in 10 feet, on joists $4'' \times 2\frac{1}{2}''$, resting on plates at each end and down the centre, $4'' \times 3''$; rounded rolls are to be fixed not more than 2′ „ 6″ apart, and the gutter is to be as that described. All necessary tilting fillets, furrings etc. are to be provided for the roofs so as to leave them in every respect perfect at their completion. The doors opening from Archway into Porches are to be hung folding with rebated meeting stiles. They are to be as shown on Plate 10, with side and frieze rails and braces $7'' \times 2''$, and bottom and lock rails $9'' \times 2''$, all stop chamfered and covered on the outside with $\frac{3}{4}''$ ploughed, tongued and beaded boarding, 6″ wide. They are to be hung on strong ornamental hinges with bolts through stiles and hexagonal headed nuts on both sides; these hinges are to be hung on hooks corked down into the stone and securely fixed. One of each folding door is to have ornamental square bolts, fifteen inches long, at top and bottom, and the other an oak stock, brass bolt, copper warded lock, bound in ornamental ironwork, with additional escutcheon to outer key hole, two keys and ornamental latch, escutcheon, and twisted ring drop handle. The prime cost of the furniture is to be three guineas for each pair of doors, and the patterns are to be approved by the architect. The inner doors to chapels are to be $2\frac{1}{2}''$ thick, framed with drapery panels and rebated meeting stiles as shown. They are to be hung folding, with similar furniture, omitting the lock, as described for the outer doors above, of the value of thirty-five shillings P. C.

The doors leading to Robing Rooms, Belfry and W. C. to be Inch $\frac{1}{2}$ panelled doors, chamfered on both sides shown on detail one eighth real size. They are to be hung on ornamental strap hinges, similar to those above described, and are to have ornamental latches and escutcheons, with an addition bolt of plain pattern within each W. C. The value of the fittings to each door is to be twelve shillings P. C.

The doors leading into rooms marked R. R. to be $1\frac{1}{2}''$ framed, ledged and braced, filled in with $\frac{3}{4}''$ ploughed and tongued boards, with bevelled vertical joints, hung as the above are described with plain strap hinges fifteen inches long, with plain good stock locks and small key escutcheon on the outside of each door.

The Water Closets are to be fitted with Inch $\frac{1}{4}$ deal seats and risers on fir proper framed bearers and grounds, fixed with screws so as to get at the apparatus. Inch $\frac{1}{4}$ deal beaded frames and mortised and clamped flaps, hung with $2\frac{1}{2}''$ brass butts; $\frac{3}{4}''$ beader skirtings, 4″ wide, round three sides of seats, and holes cut in seats and for handles.

The benches, with the stands in front for books, are to be as shown on the detail Plate 11, and are to be wrought, framed, rebated, chamfered, stop chamfered, mortised, ploughed and grooved, tongued, moulded and fixed together in a secure, neat and workmanlike manner. The sills are to be of wainscot, chamfered both sides, $4\frac{1}{2}''$ square, mortised for uprights and grooved for boarding, with cut and moulded buttresses. The boarding of standards is to be of Inch $\frac{1}{4}$ deal, 6″ wide, ploughed and tongued together (not beaded) and also to uprights on the outside; $\frac{1}{2}''$ bookboards, rebated into groove in boarding, with rounded ledge, similarly rebated into bookboards, and cut brackets. 2 inch ends to benches, cut as shown, with sunk quartre foils outside. Inch $\frac{1}{4}$ seats and standards with inch boarding to backs, ploughed and tongued. The reading desks in the Episcopal chapel are to be of the general design shown on



the sections. Sills similar to those above described are to be fixed to both, and the upper desk is to have fir wrought, framed, stop chamfered and cut posts $6''$ square, as in the margin; the front and sides of the desk are to be out of inch $^1/_2$ deal, chamfered, with $^3/_4''$ panels, ploughed and tongued into sill and capping of the profile given; the bookboard is to be similar to that already described. The lower desk is to have wrought, framed, cut and moulded buttresses similar to those of benches, of the plan shown in the margin, and filled in with panelling and capping like the desk above. The seats behind each desk may be similar to the benches omitting the sill.

The pulpits in Dissenters' Chapel are to be of the plan and elevation shown, and are to be put together with Inch $^1/_2$ stop chamfered framing, with $^3/_4$ panels and cappings all round similar to that of desks in Episcopal Chapel, and book boards also the same; 3 inch brass butts and pulpit latches are to be provided to the doors, and the seats are to be of inch $^1/_4$ deal, securely fixed, with cut standards, and a plain moulded skirting is to be put round bases of both pulpits outside, and $6''$ square skirting within. The pulpits are to be supported and the inch deal straight joint flooring carried by strong, roughly wrought, horizontal and upright braced framing, mortised and tenoned together, and all of a section at least $5'' \times 3''$. The joists being not more than eighteen inches from centre to centre. The staircase is to have inch rounded steps and risers on strong fir carriages, firmly bracketted and properly glued and blocked. The strings are to be of Inch $^1/_4$ deal, with sunk face and bead on the lower edge; the space beneath the staircase, is to be enclosed with $^3/_4$ matched and beaded boarding with square narrow skirting, all properly fixed to quartering behind at least $4'' \times 2''$. The hand rail is to be $3^1/_2'' \times 3''$, rounded, with turned newels and dovetailed square bar balusters two to each step, all of wainscot. The clerk's pulpit is to be raised only two steps above the level of the ground, which steps are to be similar to the others.

The contractor is to state the additional sum for which he will undertake to execute the benches, standards, reading desks, and pulpits, excluding the internal framing of the latter, in right Dutch wainscot, well seasoned, free from every defect and proved to be German or Riga oak. Small cisterns on proper bearers, with $2''$ tongued bottoms and $^1/_2''$ dovetailed sides, are to be provided and fixed over the W. C. in the manner directed.

The catafalques, or stands for coffins, are to be of the size shown and four feet high, and will rest on nine inch sleeper walls. They are to be framed, braced and put together with sills, heads, and uprights, not less than $7'' \times 3^1/_2''$, in a manner to be approved by the architect, and are to be covered at the top and sides with Inch $^1/_2$ matched and beaded boarding.

PLASTERER. The lime is to be from well burnt chalk limestone, free from cores and unburnt stones, mixed with sharp drift, thoroughly free from saline and other impurities. Every care is to be taken to prevent cracks, blistering and other defects. The laths are to be of pine, rent straight and free from sap shakes and knots, nailed at each end with cast iron nails, one inch long, and no fillet lathing will be allowed. The cement is to be Portland, mixed with sand in the proportion of three to one. The walls are to be dry before the rendering is commenced, and the colouring is not to be executed till the setting coat is dry.

The whole of the internal walls and vaulting are to be rendered, floated and set with stucco, finished on the surface with felted hand floats and jointed and twice coloured in distemper stone colour. Clean white sand and chalk run into putty are to compose the stucco. It must be kept thin so as not to project beyond the stone dressings to doors etc., which it is not intended to cover,

and the arrises are to be sharply kept and carefully formed. Run inch cement skirtings similar to those of wood, above all stone floors.

Before the slates are laid on the roofs over Chapels, and that part of the roofs over wing buildings which covers W. C. and rooms R. R. the spaces between the battens are to be filled in with double fir laths, and the whole covered with lime and hair plaster flush with the top surface of the battens; after the plaster is dry the under surface of the laths is to be covered with lime and hair plaster between the rafters, well gauged and finished with trowel and of the least thickness of $^1/_2$ inch. The lime, hair and sand are to be of the best description, properly tempered and laid by for use six months before wanted. The plastering is to be twice coloured dark brown to match with the timbers when it is quite dry. The ceilings of the Robing Rooms are to be lathed, plastered, floated, set and whited.

PAINTER. The white and red lead, oil and turpentine to be of the best quality; the graining to be of superior quality, and all the varnish to be the best hard drying copal. All woodwork to be effectually knotted, rubbed down and thoroughly stopped, and the rust and corrosion of ironwork to be cleaned and filed off previous to painting.

The doors are to be painted four oils, grained oak and twice varnished. The gutters and rain water pipes are to have four coats of paint, finished black; the priming coat to be of oil as well as the others. The skirtings are to have four coats of paint, finished stone colour to match walls, and the woodwork of W. C. the same, finished some common colour.

The benches, standards, desks and pulpits are to be knotted and stained with an oak stain, to be approved, and twice varnished with the best copal. If of wainscot, they are to be sized, and twice varnished: the visible portions of the roofs are to be stained dark oak but not varnished.

PLUMBER. The milled lead to be 5 lbs. to the foot; the cast 7 lbs. Provide all necessary lead headed nails; solder, dots and wall hooks, and lay the lead in gutters and flats perfectly loose and free to expand and contract, and never in greater lengths than 3 feet.

The ridges to be covered with milled lead, 18 inches wide. Step flashings of milled lead are to be fixed where walls and flues rise above roofs, laying 4″ on roofs, rising 2″, dressed into stonework 1″, and pointed in cement. The gutters and flats to have cast lead; it is to turn up against the stonework 6″, passing at the rolls and drips at least 8″, with milled flashings 6 wide, dressed into stonework 1″ and pointed in cement, or fastened with wall hooks. 4″ socket pipes to lead into rain water pipes.

The Water Closets are to be fitted with the best description of closet apparatus, with white basins, strong *D* traps, lead service box, ball levers, copper wires, air pipes, and every requisite complete. The cisterns to be lined with 7 lb. lead to the bottom and 6 lb. to the sides, turned over the top edges $1^1/_2$″ and nailed; and to have trumpet mouthed, standing waste pipes, 2″ diameter and 2″ brass washers and wastes, with 2″ waste pipes delivering into traps of W. C. and inch supply pipes to the same.

GLAZIER. The windows are to be glazed with stout lead lights of the best construction, in small quarries as in the details, and using the best strong drawn, broad church lead, secured with stout copper wires. The glazing is to be let into grooves cut in the stone jambs and mullions, the lead joints to be dressed down close to the glass, and the whole carefully pointed with white lead and oil, to render them watertight. The glass to be of the second quality of Crown, free from any defects.

SMITH. Galvanized iron bars and uprights are to be provided and fixed as described under the Mason's heading. The gutters are to be 4″ semicircular, securely screwed to the feet of rafters; 3″ down pipes with Gothic heads of plain character to be approved, properly connected with drains, but only at the outer sides of chapels, the remaining water being conducted by similar pipes so as to lead into cisterns of W. C. Wrought iron chimney bars 2″ × $^3/_8$″ to fireplaces, turned up into stonework. Provide plain gothic grates to these fireplaces.

SLATER. The slates are to be the best Countess, of a greenish tinge and uniform in colour, each slate nailed with two galvanized iron nails on fir battens $2^1/_2'' \times 1''$, bedded in mortar, cut close and even and all left clean and perfect.

For a body of *General Conditions* suitable to accompany the above Specification the reader is referred to Page 183, of the Builders' Practical Director.

The total cost of the two Chapels, if erected in accordance with the foregoing Specification, will average £ 2,300, according to locality.

THE VENTILATION OF BUILDINGS.

It is one of the most remarkable peculiarities of our dometic habitations, that, although the importance of an ample supply of pure air and the necessity of allowing that which is vitiated at once to pass away, are fully acknowledged, and although it is well known that when the above conditions are not fulfilled, diseases slowly and insidiously breaking the constitution or rapidly destroying life, according to the degree of the existent evil and the bodily vigour of those subjected to it, are occasioned, still, the adoption of means of ventilation is the exception instead of the rule. The same man who would turn with horror from food diluted in ever so small a degree with poisonous matter, carelessly continues to breathe an atmosphere polluted with poisonous exhalations until headache, lassitude, or fainting compels him to remove from it. So extraordinary a neglect of the laws of self preservation as that which now exists in our houses will render desirable a few words on the importance of an immediate remedy, prior to our practical observations on the best method of combining the warmth and ventilation so necessary to attain.

"If," says Mr. Hood, "the contaminations and impurities that are frequently contained in the air which forms the *pabulum vitæ* of human beings could be seen by the eye, in the same way as contaminations or impurity in ordinary alimentary food, the evil would not be endured for even the smallest period of time"; and "ague and fever", remarks Dr. James Johnson, "two of the most prominent features of the malarious influence, are as a drop of water in the ocean, when compared with the other less obtrusive but more dangerous maladies that silently disorganize the vital structure of the human fabric under the influence of these deleterious and invisible poisons." And yet habitations are rarely provided with means of ventilation, which are reserved for places of public resort, but are by no means invariably found even there. From the general smallness of our domestic apartments and the lowness of their ceilings, a scientific ventilating apparatus is often more necessary in them than in the church and the theatre. Dr. Lombard of Geneva observed that, in a total of 4,300 deaths from consumption of the lungs among workmen carrying on their occupations in the open air and in workshops, the proportion of deaths was double among the latter, and that it increased as the apartments were close, narrow and imperfectly ventilated. Crowded workshops indeed, such as some we have seen, appear to be devised for the express purpose of slowly destroying the health of the men employed in them; and it is surprising that some of the great employers of labour have not perceived that, from the lassitude and general feeling of inanity induced in such places, it is impossible for that amount of work to be got through, which would be cheerfully done under the bracing influence of a due and constant supply of fresh air. Not only is the vitiated air breathed again in close unventilated rooms but also the deleterious vapour with other offensive effluvia thrown off from the skin and lungs. The watery vapour alone is estimated as on the average as seventeen ounces in 24 hours for each individual. Professor Faraday remarks, — "Air feels unpleasant in the breathing cavities, including the mouth and nostrils, not merely from the absence of oxygen, the presence of carbonic acid, or the elevation of the temperature, but from other causes depending on matters

which are communicated to it by the human being. When I am one of a large number of persons, I feel an oppressive sensation of closeness, notwithstanding the temperature may be about 60⁰ or 65⁰, which I do not feel in a small company at the same temperature, and which I cannot refer altogether to the absorption of oxygen, or the evolution of carbonic acid, and probably depends on the effluvia from the many present." In living apartments, the fire in winter time, drawing as it must a certain amount of air to support combustion, is a certain aid to ventilation; but where the doors are listed, sand bags carefully placed at the windows, the keyhole often stopped, and every possible means industriously taken to keep out the pure air, who can wonder at the exhaustion, lassitude and uneasiness, the peevishness of the young and the irritability of the old, the sensation of an apparent band round the forehead, becoming tighter and tighter, and the head ache, langour and unanimous ill-temper with which a party of six or eight — after the temporary excitement of supper and the influx of fresh air from then opening the door — having been cooped up for five or six hours in a small apartment rendered as air tight as misplaced ingenuity can make it, go one after the other to bed; wondering at the oppression upon them, thinking of sending for the family doctor the next day, and repeating night after night, till at last fairly beaten, the course which is so steadily and so quietly destroying their constitutions.

In summer the opposite extreme is adopted and the windows are thrown wide open during a great part of the day, thus producing draughts inducing severe colds; the air falling downwards from the upper part of the windows like a cascade on the heads and heated bodies of those below, besides bringing in dust which is necessarily breathed with it. Were a proper mode of ventilation adopted, quite independant, as it ought always to be, of opening the windows, or were a pane of the glass to be removed and filled with perforated zinc (200 apertures to the square inch) the evils would be obviated and the windows might be kept closed. The experience of many with respect to open windows is forcibly against them, suffering as they do more from colds, tooth and face aches, during the hot season of the year than in the cold; a circumstance to be attributed to the draughts necessarily caused. We have spoken of living apartments, but our bed rooms are bad enough, although with but one occupant. Every body knows the state of one of these unventilated apartments in the morning. If the windows and doors are put together in a workmanlike manner, well fitted and tightly closed, if there is no chimney vent, and those absurd contrivances of a sickly luxury enclose the foul air in the bed, the state of the atmosphere, unchanged for eight or nine hours, is vitiated in the extreme by even a single pair of lungs, and the complaint of want of sleep is by no means surprising. The relief of escape into the fresh air of early morning is instantly felt. To this is mainly owing the cheerfulness of a breakfast party; and a feeling almost of disgust is the consequence of returning to the bed room if the window has been omitted to be opened, as the sole means which exists of getting rid of the noxious exhalations. Turning from domestic habitations to public buildings, how often do we see the lamentable effects of inattention to the simplest principles of ventilation. "In almost every large town," says Dr. Coombe, "we have instances of large public rooms capable of holding from 800 to 1000 persons, built within these few years, without any means of adequate ventilation and apparently without the subject having ever cost the architect a thought. When these rooms are crowded and the meeting lasts for some hours, especially if it be in winter, the consequences are sufficiently marked. Either such a multitude must be subjected to all the evils of a contaminated and unwholesome atmosphere, or they must be partially relieved by opening the windows, and allowing a continual stream of cold air to pour down upon the heated bodies of those who are near them, till they are thoroughly chilled and perhaps fatal illness induced; even at such a price the relief is only partial, for the windows being often all on one side of a room and not extending up to the ceiling, complete ventilation is impracticable. *This result is glaringly the result of ignorance, and could never have happened had either the architects or their employers known the laws of*

the human constitution." We see at a glance the consequences of the want of ventilation on the crowd; "either a relaxed or sallow paleness of the surface, or the hectic flush of fever is observable; and, as the necessary accompaniment, a sensation of mental and bodily lassitude is felt which is immediately relieved by getting into the open air." Indeed it is doubtful whether it would not be better to hold public meetings in the open air in the most inclement weather than in the unhealthy places described; for, according to Dr. Johnson, "it was often proved in the history of the late war that more human life was destroyed by accumulating sick men in low unventilated apartments, than by leaving them exposed in severe and inclement weather at the side of a hedge or common dike." Another deleterious agent in ill ventilated rooms is sufficient in itself to cause instant death. Gas contains a small portion of sulphuretted hydrogen which often escapes with the gas itself producing the most deadly effects. Air mixed with 1500 parts of this gas kills a bird and double the quantity a dog. "A single gas burner will consume more oxygen and produce more carbonic acid to deteriorate the atmosphere of a room than six or eight candles. If, therefore, where several burners are used no provision be made for the escape of the corrupted and the introduction of pure air from without, the health will necessarily suffer. A ventilator placed over the burners like an inverted funnel and opening into the chimney is an efficient and easy remedy for the evil; and a small tube forming a communication between the external air and the room would supply fresh air where necessary." The deleterious gases disengaged by oil, tallow and smoky lamps are productive of constant head-aches, and their intensity may be judged of from the disagreeable and wide spread odour produced from the wick of an ordinary candle which has been blown out.

The amount of general diseases, typhus fever, scrofula etc., produced in this country and the consumptive disorders traceable to the deficiency of proper ventilation are something appalling, about 28 per cent of the total deaths being attributed to it. Many indeed are ignorant of this, imagining that the temporary feeling of uneasiness is all the mischief caused by a want of fresh air. Such a feeling arises only when the ventilation is exceedingly bad; for a steady continuous injury may be done to the constitution without the sufferer being aware of it and only finding it out when perhaps too late to be remedied. The constituents of the atmosphere were first made known by Priestly, Scheele and Lavoisier, but long before their time Hippocrates had insisted on the paramount importance of breathing it in a pure state, and rules were laid down by him on the subject. Dr. Coombe was, we believe, one of the first who succeeded in reaching the ear of the general public and impressing them in some degree, through the medium of his admirable and clearly written works, with the general principles on which health depends, and the important influence on the health, cheerfulness, elasticity of feeling and comfort of a due supply of fresh air in domestic and other buildings. "An individual," he remarks, "possessing a strong constitution, may indeed withstand the bad consequences of occasionally breathing an impure atmosphere, but even he will suffer for a time. He will not experience the same amount of mischief from it as an invalid, but will be perfectly conscious of a temporary feeling of discomfort, the very purpose of which is, like pain from a burn, to impel him to shun the danger, and seek relief in a purer air. The comparative harmlessness of a single exposure is the circumstance which blinds us to the magnitude of the ultimade result, and makes us fancy ourselves safe and prudent, when every day is surely though imperceptibly adding to the sum of the mischief." He showed clearly that many circumstances rarely considered as injurious, because they have no immediate effect in suddenly destroying life by acute diseases, nevertheless slowly undermine health and shorten existence; and that workmen who may labour for twenty years without a days illness, have their general health so encroached upon that scarcely one survives his fiftieth year.

The rationale of ventilation is extremely simple. Each individual consumes per minute about one sixth of a cubic foot of oxygen, replacing it by an equal quantity of carbonic acid gas, unfit to be again received into the system. The object of ventilation is immediately to get rid of this

vitiated matter and to replace it with a sufficient quantity of fresh air to supply the space of that which escapes, the operations being simultaneous. The deleterious character of foul air is shown by a very simple experiment by Dr. Franklin: he breathed gently through a tube into a deep glass mug so as to impregnate all the air within it, and a lighted taper being then introduced was instantly extinguished, and, on repeating the operation, burnt gradually brighter as the foul air became dissipated. The air required for the combustion of the taper is precisely that necessary to carry on a process of combustion in the human body, by which the food we take is converted into nutriment calculated to support the vital frame. The expired or vitiated air naturally rises, from its specific gravity being less than that of the atmosphere around. Openings must therefore be placed in the upper part of a room to allow of its escape, and similar openings below for the fresh air to enter, be breathed, supply the fire, lights, etc., and ultimately escape into the general atsmosphere, where it is spread in sufficient space to neutralize its evil effects. The lower openings for the admission of fresh air must be large in proportion to the upper ones for the escape of the vitiated, in order thus to create a current and render the draught or rush more powerful from below; otherwise the cold air will enter from above and drive down the vitiated to be again breathed in escaping below.

We have next to determine what quantity of fresh air is essential and the amount of vitiated for the escape of which we have to provide. Dr. Arnott puts the matter as follows. "In respiration or breathing, a man draws into his chest at one time about twenty cubic inches of air, and of that air a fifth part is oxygen, of which again there is converted into carbonic acid gas nearly a half. The carbonic acid, if afterwards inhaled, would be noxious to the individual. About fifteen respirations are made in the minute, vitiating therefore three hundred cubic inches, or nearly one sixth of a cubic foot of atmospheric air, but which, mixing as it escapes with several times as much, renders unfit for respiration at least two cubic feet under common circumstances." Tredgold's conclusion was, that when a room is lighted with candles, lamps, etc., and contains several persons, four times as many cubic feet of fresh air per minute as there are persons in the room, is essential to preserve it in a healthy state — that is four cubic feet per minute of air for each individual. Having thus the quantity required, the next question is how to introduce the fresh air, and in what manner we are to settle the size, and proportion relatively the inlets and the exits.

Before giving any formula we may remark there are two modes of ventilation, the spontaneous and artificial. The former consists simply in the formation of openings to admit fresh air and exits for the escape of vitiated; in artificial ventilation, mechanical means, such as bellows, pumps, fans, etc., are adopted; or the foul air is made to pass through a furnace, from which the external air is excluded, producing a strong draught, or the upper part of a ventilating tube is heated to cause a more rapid ascent, as instanced in the large chandeliers in theatres with openings immediately above them; the former principle is that adopted in the New Houses of Parliament. Spontaneous ventilation is often inefficient in summer, because it is requisite that the temperature within an apartment shall be higher than that without, and in proportion as it is so, is ventilation successful, but the number of ventilators may be at any time increased or diminished by means of moveable slides.

Let us now return to the point whence we diverged, and, considering the ventilation to be spontaneous, settle the sizes of the apertures. Carbonic acid gas, as previously remarked, is heavier than the ordinary atmosphere, but the higher temperature in which it is when respired, and the presence of certain proportions of vapour and nitrogen, render it lighter, and it consequently rises in a room. The openings for its escape therefore must be as high, and those for the admission of fresh air as low as possible. "The openings for admitting cold air," says Tredgold, "should be almost double the area of those at the ceiling." This is essential, notwithstanding the increase of volume of the same air after being breathed; but, at the same time, efficient

ventilation is chiefly dependant on the proper size of the exits for foul air; for if a room is already full of vitiated air which cannot escape, there is no space for the admission of fresh. Again, if the openings to admit the latter are not larger than the exits, it will be impossible to cause a draught in the right direction, and the fresh air will be always liable to enter from above and drive down the vitiated air to be again breathed and ultimately escape out below where the fresh should enter. Tredgold's rule is, — "Multiply the number of people the room is to contain by 4, and divide this product by 43 times the square root of the height of the tubes in feet, and the quotient is the area of the ventilation tube or tubes in feet." The following table from Mr. Hood's work showing the quantity of air in cubic feet discharged per minute through a ventilator of which the area is a square foot, is all we need add on this subject.

Height of Ventilator in Feet	Difference between Temperature in Room and External Air					
	5°	10°	15°	20°	25°	30°
10	116	164	200	235	260	284
15	142	202	245	284	318	324
20	164	232	285	330	368	404
25	184	260	318	368	410	450
30	201	284	347	403	450	493
35	218	306	376	436	486	531
40	235	329	403	465	518	570
45	248	348	427	493	551	605
50	260	367	450	518	579	635

If there are several exits at different heights, the heighest is often the only one which acts efficiently, the lower ones, intended to be also exits, serving in fact as inlets for fresh air, cooling the heated air already risen and inducing it to descend, but the next exit to the highest will be that of the vitiated air if the latter is too small.

Having stated the general principles on which ventilation depends, it would be easy for almost any person to apply them, but we shall proceed to illustrate our observations by some remarks on the best modes of ventilating different buildings.

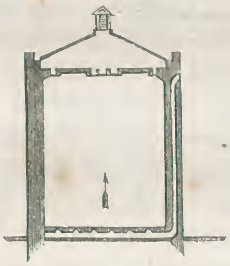
First then with respect to private houses, spontaneous ventilation will very probably be adopted. The first principles and indeed absolute requisites in the apparatus are, that it shall be simple, inexpensive, require no trouble, or care, always keep itself in order, and answer its purpose so obviously as to render it clearly useful, and thus inspire a desire in all to be possessed of it. These conditions may appear very difficult to meet, but are fully answered by Dr. Arnott's admirable and well known contrivance, which costs but a few shillings, is recommended by the Board of Health, and the utility and philosophy of which is thus clearly explained by the inventor. "Every chimney in a house is what is called a sucking or drawing air pump of a certain force, and can easily be rendered a valuable ventilating pump. A chimney is a pump — first by reason of the suction or approach to a vacuum made at the open top of any tube across which the wind blows directly; and secondly, because the flue is usually occupied, even when there is no fire, by air somewhat warmer than the external air, and has, therefore, even in a calm day, what is called a chimney draught proportioned to the difference. In England therefore, of old, when the chimney breast was always made higher than the heads of persons sitting or sleeping in the rooms, a room with an open chimney was tolerably well ventilated in the lower parts where the inmates breathed. The modern fashion however of very low grates and low chimney openings has changed the case completely, for such openings can draw air only from the bottom of the rooms, where generally the coolest and last entered, and therefore the purest, air is found, while the hotter air of the breath, of lights, of warm food, and often of subterranean drains, etc. rises and stagnates near the ceilings and gradually corrupts there. Such heated, impure air no

more tends downward again to escape or dive under the chimney piece, than oil in an inverted bottle immersed in water, will dive down through the water to escape at the bottle's mouth; and such a bottle or other vessel containing oil, and so placed in water with its mouth downwards, even if left in a running stream, would retain the oil for any length of time. If however an opening be made into a chimney flue through the wall near the ceiling of the room, then will all the hot impure air of the room as certainly pass away by that opening as oil from the inverted bottle would instantly all escape upwards through a small opening made near the elevated bottom of the bottle. A top window sash lowered a little, instead of serving as many people believe it does like such an opening into the chimney flue, becomes generally, in obedience to the chimney draught, merely an inlet of cold air, which first falls as a cascade to the floor, and then glides towards the chimney and gradually passes by this, leaving the hotter, impure air of the room nearly untouched. For years past I have recommended the adoption of such ventilating chimney openings as above described, and I devised a balanced metallic valve to prevent during the use of fires the escape of smoke to the rooms. The advantages of these openings and valves were soon so manifest that the referees appointed under the Building Act added a clause to their bill allowing the introduction of the valves, directing how they were to be placed, and they are now in very extensive use." All that is requisite is, to remove a brick in the wall near the ceiling, so as to communicate with the flue, and insert the ventilating valve, which may be procured from six shillings upwards, according to its ornateness of character.

In room without fireplaces, apertures may be made in the ceilings, which apertures may be effectually concealed, if desirable, by plaster decorations, either a centre flower being introduced or perforated cornices. In a ceiling with coffers without perforation the foul air accumulates, cools and descends, and a flat ceiling is not desirable.

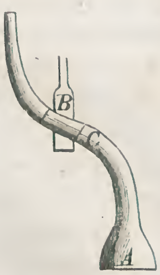
The best form is a cove with an opening in the centre, as in the diagram, with a register pulley and cord and zinc tubing to carry off the air. A variety of modes will immediately suggest themselves to the reader, by which these exits can be modified to suit diverse circumstances, and each instance will probably require individualities of treatment. Of course the exits must not open at once into the external atmosphere, as through the wall, but be led by as circuitous a route as possible to it; the object being for them to pass through air of a higher temperature within the house to that without. It is of little use having exits for foul air if there be not inlets provided for the entrance of that which is fresh. These may be contrived in a variety of ways. Openings in the skirtings of rooms, communicating with an iron air brick or grating, are common; and there should be several of these openings so as to avoid direct currents and draughts which will often arise from one alone, and they should be covered with perforated zinc (80 or 100 perforations to the square inch) further preventing draught and keeping out dust. By making a winding passage round the back and sides of the fireplace with one opening from the outside and another into the room, the air is heated in its entrance. They may also often be in the floor; and it is recommended that they should be about double in area, those of the exits. From the loose manner in which doors, windows and skirtings are often fitted, a quantity of air rushes in between the interstices, producing unpleasant draughts, but there is rarely sufficient admitted in this manner, and the draughts would of course be neutralized if properly protected openings were provided, the want of which and the necessary demand for air, especially if there be a fire, is the course of the naturally strong currents. We sometimes see, in kitchens especially, an upper pane of glass removed and a revolving fan, with radii somewhat similar to those of a windmill, substituted. These are turned by the wind and a current one way or the other produced. The object is to cause the vitiated air to escape; a great mistake, since, in nine instances out of ten, the cold air rushes in and drives down the foul to be again breathed. The same remark applies to the louvre-like slips of glass for panes now being exten-

sively advertised; and we cannot too often repeat that the openings for admitting fresh air must be at the lowest level and not placed foolishly on high. The glass bells suspended over the gas-burners in shops are a great absurdity, merely preventing the blackening of the ceiling, and not carrying off but rather retaining that deleterious air of which we before spoke of the poisonous effects. If, indeed, it be of more importance to please the eye than to ruin the constitution, the use of these ingenious means of effecting the latter is extremely valuable. The introduction of a tube from above each burner into the open air would not only carry off all deleterious matter from the burner but, from the heated state of the air around, would cause such a current as to powerfully ventilate the whole shop. If there be a fire place, one of Arnott's ventilators should be inserted; if not, openings can be made in the ceiling. A flue conducted into the kitchen chimney, nearly always active, will keep up a constant draught. Openings for the admission of fresh air may be contrived with the utmost facility in the fittings of the front and those in the shop, under the counters, etc., and zinc tubing may be advantageously employed. The fresh air is also heated if it comes in flues parallel to those by which the vitiated passes away. In factories, having steam engines, the plan of ventilation by chimney draught is preferable, as flues may be conducted into the ever-active chimney and a powerful current thus constantly kept up at virtually no cost. The lassitude, weariness, and inattention in schools and churches is often owing to deficient ventilation. The windows and doors are kept closed for several hours and the atmosphere becomes gradually vitiated in the extreme. Openings may be made in the floors, as



shown in the diagram, and the air brought from an elevation, which is better than that close to the ground or confined, through flues. Openings for its escape may be made in the roofs, whence it will ultimately reach the open air through a turret or lantern with louvres. The openings in the floors will be covered with gratings, also the openings, both inner and outer of the inlet flues; the inner openings of the latter might also be contrived out of sight in the fittings of the pews, or the desks, etc., of schools. Theatres and places of public amusement are generally admirably ventilated: the proprietors advertise the fact, and are fully aware that the success of their efforts is greatly dependant on the state of comfort in which the audience is placed. Where seats rise above one another, as in theatres, lecture rooms, etc., a simple cutting of the riser, under the nosing of the successive steps or platforms, will secure a constant supply of

fresh air, rising and taking up that which is vitiated as soon as breathed. We have before spoken of the powerful upward current caused by the large gas chandelier in conjunction with the opening above it placed in the central highest part of a theatre. The vitiated air with the products of combustion are carried up a tube terminating in a cowl on the roof. The woodcut shows a mode of creating a current to



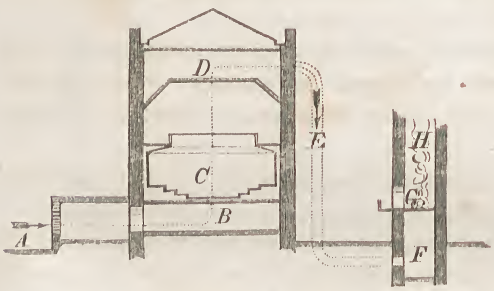
assist ventilation; *A*, being the ventilating aperture, *B*, a furnace, and *C*, an iron tube passing through it, thus rarifying the air within as to cause a strong rush of cold to supply its place. Hospitals are very efficiently ventilated by a system of fire draught, devised by a surgeon, Mr. Fleming, in 1833. A system of tubes from the wards, one being connected with each bed, partially enclosed, leads to a fire, supported solely by air from these tubes, so that the infection arising from each bed is carried off without affecting those near. This system is of course applicable generally to most buildings.

Mechanical means, such as the use of a fan, pump, or bellows, which answer the same purpose, are often adopted in artificial ventilation. Cotton mills are thus ventilated, and the Reform Club house is annother instance of the adoption of a fan worked by steam power. In the latter eleven thousand cubic feet of air are drawn in every minute, and the steam of condensation from the engine heats the building, the air being of course drawn into the basement,

whence it rises upwards. Some fanners are worked by hand and used only occasionally; they have suction and blowing pipes, the former attached to the space containing vitiated air and the latter with the external air. An apparatus of this description formerly appertained to the House of Commons, and the wheel was turned by a man during the sitting of the members. It could be made to draw out the foul and to introduce fresh air. Dr. Ure calculated that a steam engine of one horse power would drive a fan which has equal effect with a draught produced by fuel equal to twenty horse power; that is, the economy of this species of ventilation is to that by chimney draught as 38 to 1. Dr. Arnott preferred to the fan a valved piston moving like that in a pump, "which answers not only for extracting foul air, but also for forcing in pure air when wanted. It may be fixed in position, or may be a moveable piece of furniture, to be used, for instance to draw out air from the top of a window opened on a ball night, or from an opening in the wall concealed from view by a picture frame. By such a pump air of perfect purity and in any quantity may easily be sent from any neighbouring situation, as from the top of a lofty tower to supply a dwelling where unwholesome exhalations might ender by the doors and windows."

Ventilation on a large scale is often accomplished with a system of heating by hot water or steam. The library of the British Museum is heated by the air passing over pipes and thence rising through a grating in the floor down the centre of the rooms; and the combination of warming and ventilation by means of hot water pipes is, in our opinion, one of the very best methods that can be generally adopted in public buildings.

We conclude our notice of Ventilation with a brief sketch of the mode adopted for warming and ventilating the House of Commons. The diagram will render it clear. There are two floors to the House, and the air is admitted from the exterior into the space *B* through openings covered with coarse gauze at *A* to stop the soot and dust. In the vaults it is washed by means of a number of jets of water rising from pipes, laid longitudinally and transversely, filling the space with an intense spray and rendering the air fresh and pleasant. If required to be heated, it passes through another vaulted chamber where it comes in contact with pipes of hot water, and the temperature is regulated by allowing the air to come more or less in contact with the pipes by opening certain doors. In summer when the air is required to be cooled, it is effected by its passing over wet surfaces in another room, and thus cooling it by evaporation, or ice is suspended in netting. An arrangement is made for pulling down a thermometer with a string for ascertaining the temperature of the House. The air enters through openings in the floor *C*, about one sixth of an inch in diameter, 300,000 in number, and opening wider downwards to prevent stoppage by dust. The air also rises by the side walls to similar flooring in the galleries; and all the floors are covered with horse hair matting, the feet of the members being cleansed by the peculiarly contrived matting in their progress to the House, so as for them to bring in the least possible quantity of dust. About thirty six thousand cubic feet of air are thus supplied per minute, and seventy gallons of water were once sent in as moist air in a few hours. The vitiated air escapes into the roof space, *D*, and down the channel *E* into *F*, a damper in *E* regulating the supply according as the House is more or less filled. The current is set in motion by a fire at *G*, trimmed at the small door on the outside, usually kept shut, and producing a most powerful draught. The shaft *H*, rises to a considerable altitude and forms a prominent feature in the exterior view of the buildings.



In the article on the Causes and Remedies of Smoky Chimnies, will be found much information on Ventilation as applied to the consideration of that subject; and, scattered throughout the book, are numerous illustrations of patent ventilators which have been thought worthy of mention.

THE WARMING OF BUILDINGS.

In the article on the Causes and Remedies of Smoky Chimnies and throughout the work will be found numerous observations and diagrams relating to Warming, so that it now only remains to give a brief connected account of the different methods adopted. We have before spoken of Ventilation, which is a comparatively easy process, but to warm and ventilate at the same time, an end to be kept steadily in view, is often a matter of exceeding difficulty, because the introduction of fresh air, unless it be previously heated, always tends to cool an apartment.

Heat, we would first mention, is diffused by conduction, radiation and a principle of convection in fluids.

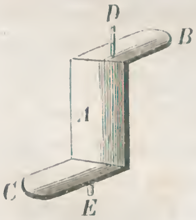
Radiant heat consists of rays diverging in straight lines, subject to the laws of reflection and refraction, from a fire and the sun, and affecting objects at some distance, its power decreasing as the square of that distance. Brilliant metallic surfaces reflect back heat, and rough and painted surfaces absorb it. Conduction is the passage of heat from one body to another in contact with it. Metals are excellent conductors, stones and bricks are bad, and porous substances, fur and clothing generally, still more so. The principle of convection as applied to heated fluids is very simple. Water is so bad a conductor of heat that it may boil at the top of the vessel while scarcely heated below. If, however, the heat is applied at the lowest part, the cold water above descends by reason of its specific gravity being greater than the heated expanded water below, and thus a free and constant circulation of water and heat is kept up, as in the instance of the pipes of a hot water apparatus.

There are two broad divisions of the modes of heating rooms now in use; heating by open fires, and by heated surfaces warming the air, sometimes by a small surface very warmly heated, as hot plates of iron and stoves, and otherwise by large surfaces moderately heated, as steam and hot water in tubes.

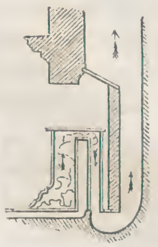
The open fireplace is the favourite mode of heating domestic apartments in England, although on the continent it by no means so extensively prevails.

When speaking of Smoky Chimnies we gave several diagrams of open fire-places and in the Articles on Labourers' Cottages will be found one showing a method of heating two rooms by one fire. We here give another example of so valuable and economical a contrivance.

"In Paris" says Dr. Franklin "I saw a fireplace so ingeniously contrived as to serve conveniently two rooms, a bed chamber and a study. The funnel was round, the fireplace was of



cast iron having an upright back *A*, and two horizontal semi-circular plates *B*, *C*, the whole so ordered as to turn on the pivots *D*, *E*. The plate *B*, always stopped that part of the round funnel which was next to the room without a fire, while the other half of the funnel over the fire was always open. By this means a servant in the morning could make a fire on the hearth *C*, then in the study, without disturbing the master by going into his chamber; and the master when he rose could, with a touch of his foot, turn the chimney on its pivots and bring the fire into his chamber, keep it there as long as he wanted it, and turn it again when he went out into his study. The room which had no fire in it was also warmed by the heat coming through the back plate and spreading in the room, as it could not go up the chimney." We add the fireplace which Dr. Franklin invented and called the Pennsylvanian stove, in which are a descending flue, through which the smoke passes before ascending, and caliducts, or passages at the back of the fire for warming air admitted through them into the apartment.

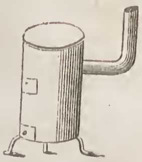


Count Rumford and Drs. Franklin and Arnott were among the first to

point out the manifest defects of the open fireplace. Even those persons seated nearest to an open fire have one side only of the body heated, the air rushing in effectually cooling the other.

Rumford estimated the loss of heat at fourteen — fifteenths; the smoke takes away one half, and the back, jambs and hearth of the fireplace reflect very little of the heat thrown upon them, being generally porous, dark and unpolished. We will give Dr. Arnott's own words. "Of the whole heat produced from the fuel used, about seven eights ascend the chimney and are absolutely wasted. Secondly, that carried off by the current of the warmed air of the room which is constantly entering the chimney between the fire and the mantel piece and mixing with the smoke. Thirdly, it is a fact that the black or visible part of the smoke of a common fire is really a precious part of the coal or wood escaping unburned. If then more than half of the heat produced be in the smoke and nearly a fourth part of it in the warm air from the room which escapes with the smoke, and if about an eighth of the combustible pass away unburned, there is a loss of at least seven eights of the whole." Altogether the objections to open fires were summed up under eleven heads. (1) Waste of fuel, (2) unequal heating at different distances from the fire, (3) cold draughts, (4) cold foot bath, (5) bad ventilation, (6) smoke and dust, (7) loss of time in lighting, (8) danger to property, (9) danger to person, (10) expense of attendance, (11) necessity of sleeping boys, now however obviated.

These formidable objections led to the gradual introduction of stoves, in many instances substituting greater evils for those sought to be obviated. One of the earliest and commonest is that called the Dutch stove shown in the margin. It is a cylindrical case of cast iron, with



a grating for the fire, an ash pit below it, and three openings to the inner part; one to the ash pit, one to introduce the fuel above, and another leading to the flue. The stove gives heat chiefly by conduction, and it is found more equalized than that obtained from the open fire, with greater economy of fuel and absence of smoke. There are however many objections, of which the least is that the fire not being seen, it often goes down, the room becomes cold, and afterwards, a great deal of fuel being put on, the room is too hot. Dr. Arnott remarked, that "the air acquires a burnt and often suphureous smell, in part, no doubt, because dust, which it often carries, is burned, and, in part, because there is a peculiar action of the iron upon the air. It becomes very dry too, like that of an African simoon, shrivelling everything which it touches, and it acquires probably some new electrical properties. These changes combined make it so offensive that Englishmen unaccustomed to it cannot bear it. The persons breathing this air are often affected by headaches, giddiness, stupor, loss of appetite, ophthalmia, etc. A north east wind which distresses many people, bringing asthmas, croups etc. and which withers vegetation is peculiar chiefly in being dry." In stoves generally, the waste of warm air which passes between the mantle and fire of the open fireplace is obviated, and by making the flue of the stove as long as possible in the room a great heat is obtained. But it is the heated surface of the iron which injures the atmosphere, a result sought to be obviated by placing an open basin of water on the stove, or what is better, hanging a wet cloth near it. Some contrivance of this description is requisite in methods of heating by metallic surfaces tending to desiccate the air. The Russian stoves are of earthenware and brickwork, retaining the heat longer than metal and diminishing its intensity near the stove. Wood is the fuel used; it is turned over until all is burnt, the stove is closed, and, in six hours, it is at its utmost heat and requires no further attention for twenty four. The air in the apartment is not allowed to escape, as the fresh air would quickly cool the room, and that stagnant and unchanged becomes intensely disagreeable and unhealthy. The porcelain stoves of the Germans are fitted together by means of close joints and grooves, sprinkled with powdered chalk so as to prevent the smoke and carbonic acid vapour entering the room. We have before alluded to the method of ventilating theatres by means of the gas chandelier. Several very admirable rules have been laid down by Count Rumford for kitchen stoves, and he

remarked that more fuel is frequently consumed in a kitchen range to boil a teakettle than, with proper management, would be sufficient to cook a good dinner for fifty men. "In large kitchens with open fireplaces, the kitchen range being wide and very roomy, an enormous quantity of fuel is swallowed up by it, even when only a very small quantity of food is provided; but this unnecessary waste is completely prevented by cooking in boilers and stew pans, properly fitted into separate closed fireplaces."

The many objections to stoves — the stagnation of the air, the often slow combustion of fuel, whereby carbonic acid gas is generated and escapes into an apartment from there not being sufficient draught in the flue to carry it off, the occasional formation also of carburretted hydrogen, and other objections have combined to produce a very general feeling against close stoves. The stoves for burning charcoal are liable to the same objections, in addition to that to the carbonic acid generated by this fuel. Warming by hot air, as it is called, that is raising plates of iron to a high temperature and conducting air which has passed over them into apartments, is similar in principle to heating by stoves, and the air is desiccated in the same manner as by them and often burnt. In the Custom House some years ago the air passed over red hot plates, and charged with the sulphurous fumes of the iron, it entered the rooms at a temperature of about 170° so affecting the health of the inmates that the system was at length given up.

The more or less injurious effects on the atmosphere of small metallic surfaces highly heated by the direct action of fire, led ultimately, first to the use of steam in pipes, and secondly to that of hot water, either below or above 212° in temperature, but so confined as to be prevented escaping into steam, and in all of which systems, instead of a small surface very highly heated there is one more extensive and moderate in temperature. The air, according to Dr. Arnott, is not vitiated by iron heated by hot water as it is when the same water is heated directly by the action of fire.

Heating by steam now so general in the factories of Lancashire, Yorkshire, etc., from the facility of applying it in connexion with the boilers of steam engines was suggested nearly a century back in the "Philosophical Transactions." James Watt first practically applied it in his Study in 1784. It was afterwards adopted in hot houses, not circulating in pipes but free in the house, heating and moistening the air in a manner peculiarly favourable to the development of the plants. The economy of heating by steam circulating in pipes is undoubted. Dr. Arnott says, "it is found that if a boiler for heating a house by steam be carefully set, like that of a steam engine, on a close furnace or fireplace, which admits no more air than is required to support the combustion, and keeps the hot air in contact with the sides of the boiler until as much as may be of the heat is taken from it, by such a boiler nearly a half of the heat produced in the combustion is applied to use, instead of the one eighth of the open fire. There is a saving therefore of three eighths of the fuel used as compared with open fires." Where there is a steam engine and it is desired to heat a room by steam pipes, they may be supplied from the boiler, enlarging it one foot cube for every 200 feet to be warmed to the temperature of about 70°, and a boiler for an engine of one horse power will heat to the above temperature 50,000 cubic feet. "In a winter day, with the external temperature at 10° below freezing, to maintain in an ordinary apartment the agreeable and healthful temperature of 60°, there must be of surface of steam pipe, or other steam vessel heated to 200° (which is about the average surface temperature of vessels filled with steam of 212°), about one foot square for every six feet of single glass window of usual thickness; as much for every 120 feet of the wall, roof and ceiling of ordinary material and thickness; and as much for every six cubic feet of hot air escaping per minute as ventilation and replaced by cold air. A window, with the usual accuracy of fitting, is held to allow about eight feet of air to pass by it in a minute, and there should be for ventilation at least three feet of air a minute for each person in the room."

Warming by hot water is now far more generally approved than that by steam. We have

before explained the principle on which the heated water is circulated to be one of *convection;* that it does not become hot by *conduction,* but through the *ascent* of the heated particles, as if warmth be applied at the top, the lower strata are very slowly affected, while, in the reverse case, the heated lighter particles ascend. There are also two systems of hot water apparatus. In the first the water does not exceed the ordinary boiling temperature 212°; in the second the water is above that temperature, often heated to 350°, and thus pressing on the pipes with a force of 70 lbs. on the square inch in the tendency to change into steam. We shall first make a few remarks on the more general method, that in which the water does not exceed 212° in temperature.

If the rooms to be heated are all on one level, an open boiler is used, that is; when none of the pipes extend higher than it, the return pipe enters the boiler at a lower level than the other. When different floors are heated, a closed boiler is adopted, in order to heat all the stories by one apparatus. The pipes are filled from above until all, together with the boiler, are full, and the heat being then applied to the boiler causes the circulation. The advantages of this method over steam are that it generally costs less, and, with an open boiler, there is no danger of an explosion. While, too, steam does not rise in the pipes until it is of a boiling temperature, the water will do so if of a temperature above that around, and will in fact be in motion immediately that the fire is lighted.

If there is a closed boiler and the apparatus bursts there is no danger, because water has not the elasticity of steam; a leakage only is the usual effect. The hot water apparatus is also calculated to be six or eight times more efficient than that for steam, even although the pipes are below 212° in temperature, while those of steam must be maintained at 212°, because alterations will constantly take place and "a given bulk of steam will lose as much of its heat in one minute as the same bulk of water will lose in three hours and three quarters." The same authority, Mr. Hood, thus settles the quantity of pipe requisite with an apparatus for water under 212°. "In churches and very large public rooms which have only about an average number of doors and windows and moderate ventilation, by taking the cubic measurement of the room, and dividing the number thus obtained by 200, the quotient will be the number of feet, in length of pipe, 4 inches diameter, which will be required to obtain a temperature of about 55° to 58°. For smaller rooms, dwelling houses, etc., the cubic measurement should be divided by 150, which will give the number of feet of 4 inch pipe. For greenhouses, conservatories and such like buildings, where the temperature is required to be kept at about 60°, dividing the cubic measurement of the building by 30 will give the required quantity of pipe; and for forcing houses, where it is desired to keep the temperature at 70° to 75°, we must divide the cubic measurement of the house by 20, but if the temperature be required as high as 75° to 80°, then we must divide by 18 to obtain the number of feet of 4 inch pipe. If the pipes are to be three inches diameter then we must add one third to the quantity thus obtained; and if 2 inch pipes are to be used we must add double the length of 4 inch pipes." Rain water ought always to be used; that which is hard and impregnated with saline matters forming incrustations in the apparatus.

The other method of heating by hot water is that patented by Mr. Perkins and consists of a continuous closed pipe of great strength with no boiler, a portion of pipe being coiled in the furnace, and filled with hot water above the boiling point and sometimes beyond 350° in temperature. The piping is of wrought iron, $^1/_2$ inch internal diameter and 1 inch on the exterior, one sixth of its length being coiled in the furnace.

The pipes are proved at a pressure of 3000 lbs. per square inch, but even supposing the pipe to burst at any point there would be no danger, for the jet would be converted into steam, which would not scald, and the real damage would be of trifling amount, consisting in the repair of the apparatus and the injury from the jet of hot water. Dr. Arnott objects to the system from the great strength required for the pipes, the trouble of the safety valves, the liability to bursting,

and, from the high temperature of the pipes, a disagreeable smell being often given to the air, showing it is injured. Mr. Hood objects to the coil cooling so rapidly when the fire slackens; and, altogether, for permanence of temperature, economy, freedom from danger and comparatively slight trouble, we ourselves strongly incline to the belief that the hot water apparatus with large pipes filled with water under 212⁰, is the best system which has yet been devised.

DESIGNS FOR SHOP FITTINGS.

Plates 12. 13. 14. 15. 16.

These plates contain a series of designs for the external and internal fittings of a shop, 32′ „ 6″ $\times$ 26′ „ 0″, with a clear height inside of 12 feet; the frontage is 31′ 0″ and the height of the frontage 14′ „ 9″. Plates 12, and 13, show the plan and the external and internal arrangements. The piers at the sides of the front are to be built in brickwork set in Portland cement with the face of pilasters accurately cut. The central pilasters are to be formed of inch $^1/_2$ yellow fir, mitred at angles, glued and blocked capitals and bases, with grooves for brass bars, and also fitted for iron shutters. The bars are to be 3 inch Clark's patent bars, with wrought iron core and hard wood moulding screwed on the inside to secure the glass; arched heads and capitals and bases as shown. The arched heads of the brass sashes are to be filled in with $^3/_4$ deal in grooves, with *papier-maché* ornaments on the exterior. The entrance doors may be $2^1/_2$″ bolection moulded and raised marginal lower panels, the upper open for glass, moulded on one side and with beads screwed on with countersunk brass screws on the other. They are to be hung on Redmund's patent swing centres, or on brass swing hinges (one hinge and a pivot); and are to have also two brass flush bolts at top and bottom and one in the middle, together with finger plates, etc. Wrought, framed, single rebated, double beaded and double staff beaded transom, with 2″ circular fanlight, hung on brass centres and fastened with brass flush bolt. Inch $^1/_2$ moulded soffite, tongued and securely fixed. Provide Portland stone landing, moulded on the front edge, rubbed and back rebated to the boarding, which latter may be $1^1/_4$″ laid folding on joists 14″ from centre to centre, and 10″ $\times$ $2^1/_2$ if they are carried at the centre of their length. Very strong fir framed cradling is to be fixed in the manner shown on Plate 14 to carry entablature, soffites at entrance and show spaces. The freize is to be of Inch $^1/_4$ Honduras mahogany, firmly secured to cradling, and the mouldings are to be of deal, fixed together in the most secure manner, with tongues, blocks, screws, etc.; inch cover board on proper bearers, the dentils being screwed in: the breaks over pilasters are to be carefully mitred at the angles together with the mouldings, etc., the arrises being kept quite sharp. The enrichments of the front may be in *papier-maché* with a priming of whiting and glue over it; or *carver's compo*, a mixture of glue, resin and whiting, may be adopted. The last is not brittle and ornaments can be more easily bent and adjusted than if they are in other materials. *Carton-pierre* is a light material; the enrichments are to be fixed with screws. We have shown a girder carrying the wall above the shop, but of course the mode in which this is done will depend always on circumstances; whether the house is built with the shop, or the shop after the house is erected; in which latter case the old bressummer, iron girder, or other mode of carrying the superincumbent weight would probably be retained.

The formation of new shop fronts to old houses is oftentimes a rather difficult task, calling for the utmost amount of care and circumspection to prevent the least damage to the superstruction in the shape of settlements, etc., as well as injury often caused to the adjoining pre-

mises. The wall above should be carefully and most securely shored up, and fully supported by upright pieces of timber which cannot possibly settle or give way in the slightest degree; which end must be attained by the introduction of wedges, etc., before a single brick or a single piece of timber on which the superstructure depends in ever so slight a degree is removed. If the above consideration is not shown, although a structure may perhaps not fall down, yet, after the works are completed below and the proprietor has decorated his house, unsightly cracks and settlements above, especially if the front be stuccoed, will spoil the whole effect, and necessitate fresh expenses. If again, in internal decorations, the utmost care be not taken to carry the supports of the floors above, to guard against the removal of walls or partitions which carry others over them, or to support these latter carefully while introducing girders, the consequences will soon be visible in the cracked ceilings and walls and distorted fittings. New work, brickwork especially, always takes a certain time to settle to its proper bearing, and this accounts for the consequences of alterations carelessly conducted not appearing very often for some time after their completion. In houses built some years back alterations may be more safely made than in in many modern structures, because the former are generally more substantially built, and will consequently bear better the loss of some of their parts; while many new structures are so slightly put together — and things in this respect are getting worse and worse — that if one apparently disconnected part is taken away the whole will instantly fall to the ground. Many houses in rows as now erected would never stand alone, and it is often found necessary to introduce provisions in leases prohibiting dancing on the upper floors.

The girder shown to carry the wall of the superstructure should be laid on templates of York stone with a layer of felt between the girder and the stone. York stone should also be laid along the top of the girder to carry the brickwork, not laying the bricks directly on the girder. Two girders coupled together with $^3/_4$" wrought iron bolts, passing through a wrought iron socket, with wrought iron ferrules, nuts, screws etc. will be found far better than one. The cast iron girders should be of the best soft grey metal, mixed with a small portion of hard metal to stiffen it, and the utmost care must be paid to the quality of the castings; flaws and defects may cost many lives. In an early portion of the work will be found a formula for the calculation of the size of girders to carry given weights. The quality and strength of girders should be *tested* before they are brought into use; they should also be weighed at the foundry. Provision should be made in the Specification that all this should be done at the expense of the Contractor, and the castings should be well cleared from rust and corrosion and receive two coats of good oil paint prior to being used. An hydraulic press is employed for testing the strength of girders. Many founders have not one, and efforts are often made to escape the trouble of testing and only weighing the girders, but unless the proof is applied in the presence of the architect or his representative there can be but slight assurance of safety.

The wood framework of the shop is shown in detail and requires but little explanation. An inch $^1/_4$ cross tongued show board is to be supported on the framed bearers. The show board is rebated at both ends into a groove in inch $^1/_4$ moulded upright framing towards shop and similar framing panelled in the manner indicated in the shop front. Both framings are rebated at bottom to the skirtings and base mouldings, which skirting in the shop is to be rebated into a groove in the flooring, the whole being secured to the framed bearers shown; the stall board and mouldings are to be as indicated. The sliding sashes are to be inch $^1/_4$ ovolo moulded, with frame and all necessary beads, fillets etc. The soffite is rebated into inch $^1/_4$ upright stuff which takes up with cornice. The sashes at the sides of entrance are to be similar to the others but fixed with small beads. These sashes and frames, together with the doors, may be of yellow deal or Honduras or Spanish Mahogany. If of deal they will be grained as may be preferred, and twice varnished in copal. The ends of show spaces are to be lined with $^3/_4$ matched and beaded boarding. Bunnett's patent revolving iron shutters are proposed. Their cost is from

5 or 6 to 8 shillings per foot super. They are also manufactured, under Clarke's patent, of wood for about 3 or 4 shillings per foot super. Clarke's iron shutters are also extensively used. Some wood revolving shutters are patented by Snoxell, and there are others with laths shod with iron. These gentlemen are we believe the only patentees of revolving shutters. Their utility is unquestionable, and their strength and security infinitely superior to the ordinary wood shutters, independently of the great dimunition of trouble they occasion and the inconvenience saved to passengers in the streets; as it is a perfect nuisance and often dangerous to walk by shops when they are being closed on the old method, shutters being often suddenly thrown up from below against casual passengers. We wish to be perfectly impartial with respect to the relative method of the different patents and the reader must judge for himself. We may mention that these shutters are extensively adopted in private houses, and there can be no doubt of their efficiency. The cumbersome internal shutters are obviated, and, as to the external shutters hung as doors, they are inadmissable except on the most ordinary habitations. In an earlier part of the Practical Director will be found some further remarks on shutters with some illustrative diagrams. If the ordinary shop shutters are adopted, they may be inch $^1/_4$ bead flush and square shutters, shod with iron at the angles, with lifting plates. 2 inch wrought iron bars, with plates, staples, and thumbscrews.

The walls and piers in the interior are shown in brickwork, although the projections between the bookcases and the plaster all round might be executed in 1$^1/_2$ yellow deal; the latter having mitred angles. The whole of the brickwork and the decorations are to be executed in floated, trowelled stucco. This on flat surfaces may be set down at eighteen pence per yard super. The various cements may be advantageously substituted for it, Martin's, John's, Parian or Keene's. Their expense will be the probable objection. The stucco may be composed of fine stuff, and clean washed white sand in the proportion of 3 sand to 1 fine stuff; chalk lime is used. It is worked on a floated surface, which must be perfectly dry before the stucco is laid on. Spread it in squares of about five feet, sprinkled with water and thoroughly rubbed till the surface is quite hardened. It must be perfectly dry before paint is applied. French plaster is suitable for work when great dispatch is requisite; it costs about eighteen pence per yard on brickwork. Martin's, John's, Keene's and Parian cements may be painted within a few days of being finished. They average two to two shillings and sixpence per yard. Plate 16, is a detail of the cornice half full size. Gauged stuff, composed of fine stuff, putty and plaster of Paris, may be used. The enrichments are cast and fixed with plaster or screwed on; their material we have already mentioned: brackets 12 inches apart with laths nailed to them are requisite. Plate 14 shows the sliding sashes and the drawers between the pilasters at the sides of the shops.

These recesses are to be arched over with nine inch arches in half brick rings, breaking joint, and the circular space below is to be filled in with inch $^1/_2$ moulded framing, the mirror secured with a bead fixed with brass countersunk screws; or this part may be made to turn on centres, thus rendering available the space behind. The sliding sashes are to be fixed as indicated with all requisite beads and fittings. There is to be an inch $^1/_2$ top rebated into groove in inch upright framing, and inch $^1/_4$ bottom. Dovetailed drawers, with $^3/_4$" beaded fronts and bottoms, $^1/_2$ sides and inch divisions. The fastenings will be as preferred. The mouldings above sliding sashes are to be in deal, uniform and continuous with those in plaster. Inch shelves with proper bearers are to be fixed within cases. Inch skirtings uniform with those in plaster, and all necessary internal framing and blocking are to be provided. All this woodwork will be executed in either mahogany or deal according to considerations of expense. The prime cost of Wainscot or Honduras is about 10 pence and Spanish one shilling more per foot, the labour is of course considerably above that on deal.

The circular recess at the end of the shop is to be as shown and lighted by means of a skylight above; light might also be obtained over the chimney piece. It is always preferable to have a

double skylight, as well for the purpose of warmth as to thoroughly exclude moisture. The outer skylight may be of 2″ deal with a wide frame to protect the lower parts. It is to follow the same rake of the roof and be blocked up so as to stand above it; lead flashings are of course requisite.

Plate 15 contains details of counters. The top should be of Mahogany, moulded one edge and rounded the other. Wrought and framed legs and bearers and inch battens to bearers. Inch $^1/_4$ moulded fronts rebated above as shown and also into grooves in pilasters, which latter are to be wrought, framed, grooved and put together with $^1/_2$″ panel in the centre and moulding round; $^3/_4$″ wrought both sides cross partitions. Dovetailed drawers, wainscot glued sliders, rebated into groove, and rebated runners. Locks are to be provided and the remaining finishings are to be as on the detail, the shelves, etc. being out of inch $^1/_2$ stuff. Mahogany is not only the more handsome but altogether the more preferable and durable material for counters.

Plate glass will in all probability be preferred throughout for the exterior and the interior. It should be as colourless as possible and entirely free from spots and defects. For the doors it should be bedded in washleather, in other places fixed with beads. The outer skylight may be glazed with sheet glass well stopped with oil putty; it may be 21 oz per foot super. Either patent or British plate glass may be used; the latter is preferable. The compartments in the front may be glazed with two or more sheets, the edges being ground and fitted closely together. A saving is thus effected, and the cost of ground edges is only about a halfpenny per foot run. Bending plate glass costs about three shillings per foot super; for plates for silvering about one shilling per foot super may be added to the price of patent plate. The plate glass should not be less than $^1/_{10}$ of an inch thick, or of the weight of 21 oz, per foot super.*

The exterior is to be run, moulded and finished in Portland cement, 2 sand to 1 cement. The moulds for the cornices should be approved previous to use and the arrises accurately cut. The dentils are to be screwed on. The cement is proposed to be finished in decorative colours, by which means a very brilliant effect may be obtained at a comparatively small cost. The small decorations are to be picked out in blue and gold. We shall take occasion to make a few remarks, which will guide those not versed in the subject, respecting the harmonious selection and juxta position of colours, so as to obtain a pleasing and tasteful result and to avoid that vulgarity which is consequent on want of information respecting a few simple rules. The internal stucco work will require five coats of paint if the plaster is very absorbent. The last is to be mixed with turpentine to obtain the effect termed *flatting*, one without gloss. If however the work is not flatted, the finishing coat is to have one part of oil to two of turpentine. Boiled linseed oil to the priming coat, then three coats of white lead and oil and afterwards the flatting coat. Care must be taken that the plaster be quite dry; if it is not so, distemper colouring is preferable as a temporary matter. The ceiling is to be lathed, plastered, floated, set and whited. The cost of the shop front, if executed as described with Portland cement, plate glass, yellow deal, brass sashes, and painted four coats in party colours will average £ 180. The interior, stuccoed and flatted, with deal fittings grained maple, plate glass, marble chimney piece, etc., will come to about £ 350.

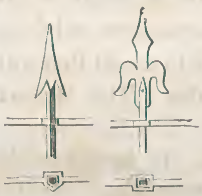
We think that the above general remarks will be found more useful in this instance than a simple detailed Specification, as it is difficult to give general designs for shop fittings which can be executed exactly as delineated. At page 213, of the Builder's Practical Director will be found four complete specifications of the exterior finishings of shops, the details of which are also supplied.

DESIGNS FOR CEMETERY ENTRANCES AND LODGES.

Plates 17. 18. 19. 20. 21.

It will be perceived on a glance at these designs that they are applicable to many other purposes besides that which has immediately suggested them, and the same remark very forcibly applies to the series of working drawings which accompanies and illustrates the Cemetery Chapels. It is our aim to render the whole of the designs of such a character that they shall be not only suitable to their original destination, but, with as little modification as possible, be found suggestive of numerous applications and thus meet the various requirements of our readers.

Plate 17 is a convenient arrangement of the boundary walls and entrance gates to public grounds, whether for cemetery, pleasure or other purposes. The receding curve allows that space, so requisite in a public and much frequented road, to enable vehicles to draw up and wait without disturbing the regular traffic. The walls are kept low with an open railing, thus allowing a view into the grounds and meeting the 15th requirement of the Instructions of the Government relating to Cemetery arrangements. "The best fencing for a burial ground is an open iron railing on a dwarf wall or a sunk fence. High walls are quite unnecessary; they increase the cost of the ground, interfere with the ventilation and cut off many points of view which it might be desirable to preserve." The walls may be constructed in a similar manner as described in the full specification of the Cemetery Chapels; the dressings need only be tooled. The iron gates are shown in detail on Plate 20 and explain themselves. The quartrefoils and leaf enrichments at the upper part and the trefoils below are to be cast separately and let into grooves. The mode of hinging is fully explained; the pivot at the bottom is to be of steel with a wrought iron shoe. The ornamental finials are to be screwed on above the hinge, and the pendants under the gate will also be screwed up after the bars are fixed. The smaller rails on dwarf walls are to be as in the margin; they are to be let into the stone and carefully pointed in cement. The two side gates are to be of oak, from Sussex as the best; one is the entrance to the lodge; the other will be found useful for many purposes, more especially if an additional lodge for the sexton be erected, as is often done, opposite that for the Cemetery keeper here shown. The piers and the wall are as simple as they can well be, but will be found exceedingly effective in execution; a result which can be often obtained without much ornamentation and at a small cost.

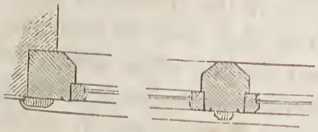


The house for the Cemetery keeper is arranged with that amount of accomodation which is generally required. It will also be found applicable to many other purposes, being a compact and convenient little residence comprising the following accomodation; —

Parlour	16′ „ 0″ × 16′ „ 0″
do.	15′ „ 0″ × 15′ „ 0″
Office	16′ „ 0″ × 16′ „ 0″
Kitchen	15′ „ 0″ × 10′ „ 6″
Scullery	10′ „ 6″ × 10′ „ 6″
Entrance Hall, W. C., Pantry and Coal Cellar.	
Two Chambers each . . .	16′ „ 3″ × 16′ „ 0″
One „	15′ „ 3″ × 15′ „ 0″
One „	15′ „ 0″ × 10′ „ 9″
Closet	11′ „ 0″ × 5′ „ 6″
The height of Ground Floor is .	11′ „ 3″
Do. Chamber „ . .	10′ „ 6″

The entrance is so arranged that persons going to the office do not enter the private portion of the house, a point of some importance.

Plate 17 shows the Ground Plan and Front Elevation together with enlarged details of the window heads to be executed in stone. On Plate 18 are the side Elevations, and Plate 19 contains the Chamber plan and a Section exhibiting the construction. This latter it will be perceived is extremely simple and economical. There is a *collar roof* of slight span, and the rafters and collars need not be more than 5″ × 2½″. The joists of the floors may be 9″ × 2½″. The walls are to be similar to those described in the Specification of the Cemetery Chapels; the dressings need not be rubbed but only tooled fair. The roofs are to be slated, and are to have Williams's patent slate ridge and hips, with circular roll and flat sides 14″ girt, and costing, set in cement, one shilling per foot run. The valleys must have 5 lb. lead. The windows are to be



inch ½ chamfered casements as in the margin, hung on 2½″ butts to fir solid, rebated, chamfered and beaded frames 4″ × 4″, weathered and grooved sills, with iron water bar, proper stay hooks and iron crank fastening, all galvanized. In two light windows one of these casements is to be fixed. The entrance lobby to office is to be paved with encaustic tile paving, figured red and buff, and costing glazed two shillings per foot super. The remaining rooms are to be boarded with inch ¼ yellow deals on the ground floor and white deals on the chamber floor, all laid folding; but the scullery and offices connected with it are to be paved with 2½ tooled Yorkshire stone. The office and lobby walls are to be finished with trowelled stucco painted, and the remaining rooms with ordinary plaster papered, excepting the Kitchen offices which are to be twice limewhited.

Plate 21 contains designs for the chimney pieces of a character to accord with the style of the house. No. 1 is for the bed rooms, 2 for the parlours, 3 for the office, and the details of the mouldings are given on the same plate one quarter real size. These chimney pieces may be of Bath or Caen stone.

The estimated cost of this residence together with the iron and wood gates and the walls forming the entrance to the grounds is £ 1350.

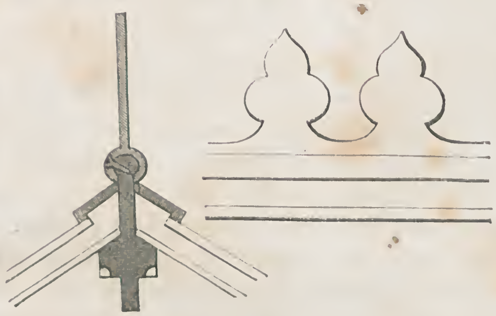
DESIGN FOR A GREENHOUSE.

PLATES 22. 23. 24.

These plates contain plan, elevation, section, and details for a small Greenhouse, 23 feet by 14, of a substantial and convenient description, with a slight amount of decoration on the exterior. It may be erected in the most economical manner against a house already built; otherwise the wall at the back, a serious item in the expense, will have to be carried up exclusively for it. The mode of erecting and finishing conservatories and greenhouses is so various and so dependant on peculiarities of taste that we shall make some remarks on the subject, which will perhaps be more useful than a detailed specification of the present design.

Wood is the ordinary material for the frames and sashes of greenhouses, the former resting on brick walls. It is of great importance to interrupt the rays of the sun as little as possible, and iron and zinc are in this respect preferable to wood frames, which are necessarily of greater breadth. Whatever the material, a slope of 34° is found to be the best for the roof to admit the rays of the sun with the greatest advantage to the plants. Sometimes malleable iron sash bars bent to a curve are used for the roof.

The cast iron ridge bar into which they are leaded should have cast iron pockets and be screwed at the base to the gutters, also of cast iron. On the top a cast iron ridge will form an appropriate ornamental finishing. The diagram in the margin shows how it may be fixed. Zinc is a much cheaper material than iron for greenhouses. Casements will add to the expense, but the fixed sashwork may be put up at the cost of one shilling per foot super, including the necessary woodwork. In the design given the framing is wholly of wood and may be put together by any carpenter, although many tradesmen who devote themselves solely to the erection of greenhouses try to make out that there is something peculiar in them which is not understood by the ordinary builder; and for the extra skill which is supposed to be required they charge accordingly. The general form in our design is as cheap as any, domes and circular forms causing irregular cutting of the glass, adding greatly to the expense. A Writer in the Horticultural Magazine gives the following estimate of the cheapest possible description of greenhouse. "There are to be had many carpenters who are clever at such work, and who will execute the woodwork of any of these buildings at one shilling per foot. Suppose therefore we calculate that a lean-to greenhouse has three feet of woodwork upright in front above the low brick wall and two six feet lights from back to front, and three feet six inches wide, and that there are ten of these lights side by side to make the length of the house, which would then be thirty-seven feet. Suppose the tops are sloped so as to give us ten feet for the depth of the house, there would then be three times thirty-seven feet (111) for the upright front, and twelve times thirty-seven feet (444) for the roof, and say sixty feet for each end (120); the doors will add about 20 feet. We now get at the total number of feet, which is 695, which number of shillings, thirty four pounds fifteen shillings, gives us the carpenter's work. We will reckon the glazing of the roof, or 444 feet, at $4^1/_2{}^d$, eight pounds three shillings and two pence, and the rest of the glass, 231, at 8*d*, seven pounds fourteen shillings. There would be wanting the price of the bricklayer's work only to complete the building, this depending a little on the price of the material in the locality, for sometimes the distance the bricks have to be drawn makes a good deal of difference; but the height of the brickwork, say eighteen inches in the ground and two feet six out of the ground, together four feet, with the ends, fifty-seven feet in length. This should be nine inch work; say it will cost ten pounds, making sixty pounds and under sixty-one. The heating of a house like this would require a conical boiler, say three pounds; and eighty feet of pipe, at eighteen pence, six pounds, and fixing, say two pounds more. Here then is a greenhouse thirty-seven feet long and ten feet wide for about seventy pounds. This includes the fastenings, hinges and necessary means of heating. The fitting up of the inside is so completely a matter of taste that it is impossible to say what would be the cost until the intended plan is known. The best way to fit up a greenhouse is with a table or rack in front, two feet wide, and shelves the form of the roof the other side of the last." For the sum named the work will, of course, be of a very common description, and an addition of £ 10 should be made to the estimate if it is desired to have a substantial erection. On Plate 24, will be found enlarged details of the sashes and frames of a greenhouse. The wall below is fourteen inches thick on three courses of footings, the lower double, and the face above the ground cemented. There should be a stone sill to carry the framework. The roof is to be formed with wrought, framed, rebated and chamfered beams, with weathering as shown, nailed at top and abutting below on a solid, strong, continuous head, chamfered, framed together and pinned at the angles, and further secured with a wrought iron strap at each joint; that next the wall on each

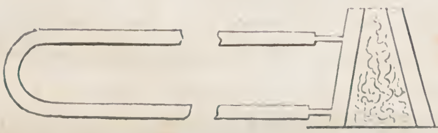


side to be let into it; fix wood cavetto as shown under gutter. The uprights are to be chamfered, with moulded caps and bases, and the head next to the wall against which the beams abut is to be of hard wood, chamfered lower edge, and may be secured to the wall with iron straps, screws, etc. The cross bearers are to be as shown. The top lights of greenhouses are sometimes fixed, but generally the upper ones are made to open. They may be hung on butts or strap hinges to the curb at the top and be fitted with staying bars, with long handles and proper pins and plates; or, as we have shown them, be made to slide open more or less by means of a pulley and cord attached to the curb and the upper frame of the sash. Sometimes each light is specified to have four strong hip rollers in plates, with strong lines, large pullies and iron weights of the P. C. value of about fifteen shillings. The upper sashes of greenhouses may be from 2 to $2^1/_2$ inches thick, with cross bars for the lights and wide framing to protect the lower part. The lower horizontal sashes are sometimes hung with strong butts to the head above and provided with staying bars to keep them open more or less. We have shown lifting sashes, every alternate one being fixed either above or below. The sills should be of oak, 3 inches thick, sunk to 2 inches, and framed and pinned together at the angles. Deal cased frames with the necessary beads to fix the inch $^1/_2$ ovolo sashes; brass cased pullies, patent lines, cast iron weights and spring sash fastenings. These details are shown one-fifth real size and therefore need no further description. On Plate 23, is a side elevation and transverse section. The sashes above are to be fixed. The door may be inch and a half sash door with moulded panels and haunched lock rail, hung on 3″ butts, with 7″ mortise lock and brass handles. Fix proper rebated and double beaded door case 4″ $\times$ $2^1/_2$″, transom 3″ $\times$ $2^1/_2$″, double rebated and beaded three edges; inch beaded fan light, with bead cut for it, hung on centres and fastened with small bolt. The arrangement of the stands for flowers inside greenhouses and conservatories is very various according to differences of taste, and depends also on the open space it may be deemed desirable to preserve. We have shown on the plan and section on one side a series of stands in the form of steps of different widths one above another supported on framing, and on the other a continuous table on strong framed legs and bearers, about 3 feet high and 2 wide, it being the arrangement generally adopted in greenhouses of this description. The tops may be covered as shown on the detail with yellow deals, 5 inches wide, placed half an inch apart.

Greenhouses should have stone paving laid to a proper fall, so as to carry off the water flowing over from watering the plants. $2^1/_2$ Tooled or rubbed Yorkshire stone, 2 inch rubbed Portland, or any stone that is at hand suitable to the purpose, may be used. Where there is no basement, a bed of concrete, 6 inches in thickness, the surface being made perfectly level, will be the best substratum, and the slabs of stone should be joined in cement. 4 inch glazed stoneware tubular drains, with proper bends and junctions and Haywood's traps, are to be laid with a good fall to carry off the water, as well from the roof as from within the greenhouse. The water from the roof will however be probably collected in a tank in the building. Slate is the best material; inch $^1/_4$ bottom and inch sides, grooved and tongued together with white lead and bolted with $^3/_4$″ rod bolts, with nuts and screws complete. The gutters may be of iron of the form shown on Plate 24, costing about ten pence per yard run, and a 3 inch down pipe, costing about one shilling per yard. If the gutters and pipes are galvanized they will cost about once and a half the above prices. Lead flashings out of 5 lb. lead are to be fixed as shown at the top of the roof. The whole of the wood and iron work should be painted four times in good oil colour inside and out. 21 oz sheet glass may be used for the roof, the joints overlapping $^3/_4$″ and well stopped with good oil putty. Hooks of lead are often used, especially in curved roofs, to support the lower edge of every pane from the upper one of that below. Horticultural glass may be procured in lights 12 inches long and ten inches wide, and also 40 inches long and 3 feet super; it weighs per foot super. 13. 16. and 21 oz. Hartley's rough opaque glass is excellent for the roofs of greenhouses, as it prevents the scorching of the plants by the excessive

heat of the sun; it may be $^1/_4$ inch thick; and it has the further advantage that it is not easily broken. Coloured glass is sometimes used in conservatories, but its adoption is not to be recommended, altering as it does the natural beautiful appearance of the plants and giving them all manner of inappropriate hues.

Conservatories are generally heated by a hot water apparatus, and on this subject the reader will find information, as well as particulars of the length of piping required to maintain a given heat, in the article on the Warming of Buildings. A porch is desirable to a conservatory in order not to admit too suddenly the cold external air; it being necessary to maintain an equable heat, the average of that of the country where the plants are indigenous. Openings for admitting the requisite cool air should be formed on the shady side of the house; and it is not desirable to bring this fresh air from the immediate level of the ground but rather from a higher region down passages formed in the wall of the building. A very small boiler will suffice to heat a very large conservatory. The diagram in the margin shows an ordinary form, like two flower pots inverted, the fire being in the middle and the water around it. The fuel is introduced at the top which is then closed and speedily generates a great heat. The water begins immediately to circulate on the principle of *convection* explained; and, with respect to the pipes, all that need be attended to is, that, as the heated particles of the water rise, the supply pipe shall go out of the boiler at a higher level than the return pipe, which brings back water cooled, to be again heated, rise and circulate through the supply pipe. When the fire is thoroughly lighted, the aperture may be filled and covered, the regulator of the flue being closed in that degree to allow of a steady slow combustion. The pipes are sometimes sent through shallow tanks of water covered with tan or soil, in which pots are bedded or plants grown, thus communicating a great degree of heat. The hot water may be carried by the pipes through the tank or be discharged into the tank at one end, circulate and be carried onward by a return pipe at the other. In the design given we have not shown any heating apparatus; but if it is desired, the floor of the stove may be two or three steps below that of the greenhouse. Hollow walls are very effective in retaining the heat. The cost of this greenhouse, if erected and finished in the best manner, in accordance with the general description given, will average £ 90, exclusive of the cost of a heating apparatus.



As the words Greenhouse and Conservatory are often confounded we will close this article by defining them.

A Greenhouse is used for sheltering plants in pots which are too delicate to bear the open air in this changeable climate in cold and inclement weather. The pots are placed upon stages, while, in a Conservatory they are planted in beds of earth, or free soil. An Orangery has a closed, ceiled roof, thus differing from Conservatories and Greenhouses, the roofs of which are glazed. Plants producing flowers and shoots in the open air during the summer are preserved in Orangeries during the winter, or in Conservatories. A Greenhouse, Gwilt remarks, "should not be far away from the dwelling house, that the greatest enjoyment may be had from it. At the same time, it should, if possible, be near the flower garden, as being of similar character in use. The length and breadth can only be determined by the wealth and objects of the proprietor. The best aspects are south and south-east, but any aspect may, in case of necessity, be taken, if the roof be entirely of glass, and plenty of artificial heat be supplied. In those greenhouses, however, which face the north, the tender plants do not in winter succeed so well, and a greater quantity of artificial heat must then be supplied, and the plants should, in such case, be chiefly evergreens, and others that come into flower in the summer-season, and grow and flower but little during the winter. The plants in greenhouses are kept in pots or boxes on stages or shelves, so

as to be near and follow the slope of the roof, and thus made more susceptible of the action of the sun's rays immediately on passing through the glass. A Conservatory should be more spacious, loftier, and be finished in a superior style to a Greenhouse. It should be seated on a dry spot, so as to receive during the day as much of the sun's heat as possible. It is to be provided with flues, or boiling water pipes, to raise the temperature when necessary; there must also be contrivances for introducing the fresh air when required. In summer time the glass roofs are taken off, and the plants exposed to the open air; but these are restored always, if taken off, on the slightest indication of frost."

DESIGN FOR SHOP FITTINGS.

Plates 25. 26. 27. 28. 29.

The decorations and descriptive details of this series of designs for shop-fittings will be observed to be of a totally different character from those before given. In this instance also the whole of the internal finishings are of wood, excepting the cornice, while in the last series the decorative details were shown to be executed in stucco on brickwork. On the exterior also, instead of girders to carry the wall above with wood facings, the preferable plan of turning arches has been adopted.

Plates 25, and 26, show the general arrangements and the external and internal effect. Plate 27, is an enlarged detail of the shop front. Brick, stone (either Portland, Bath or Caen), and Portland cement are proposed to be used. The sashes are to be of brass, with iron revolving shutters, on the advantages of which we have already spoken. The woodwork of the doorway, etc., will be preferable if of mahogany. The projecting consoles at the ends of the shop front should be of stone, and indeed the central part over the doorway will be best constructed of it; otherwise brickwork with cement $^3/_4$" thick may be used; the utmost care must be taken in turning the arches, which are to be in half brick rings. The extra expense of using stone entirely would not be much; and if the material be well chosen, its durability and superior effect are ample compensation for the increased investment in a front where there is much decoration, and the labour in producing a satisfactory effect in cement is great.

Plate 28, show in detail the cases at each side of the shop. The pillars are to be of Mahogany with carved capitals and the doors to the cases also of the same wood, Spanish being of course much more expensive than Honduras. The rest of the framing may be of deals. The mouldings are to be securely fixed and neatly finished, and the whole is to be wrought, framed, rebated, stop-chamfered and put together in the manner shown on the plan and section. The closets below are also to be as indicated, with inch $^1/_2$ stop-chamfered panelled doors, hung folding on brass butts (as are also to be the doors to cases), with brass tumbler locks and ebony handles. The backs of these closets and cases are to have $^3/_4$" matched and beaded boarding. Plate glass, fixed with a bead, is to be used to the cases. The profile of the cornice is shown and bracketting is to be provided. The framing above to take this and the formation of the compartments of the ceiling shown on the Longitudinal and Transverse Sections will depend on the nature of the original works existing above, of which it is impossible for us to take cognizance. If the house is built with the shop the construction will be arranged accordingly. The enclosed show place in front of the shop is to have sliding sashes as shown on Plate 26, and to which the details of sliding sashes before given will apply. These sashes may be of deal or mahogany. Mahogany veneered doors, we may mention, are much used. The prime cost of veneers to panels is 6*d*,

and to framing 4*d*. Sometimes the panels only are veneered, the mouldings being of Spanish mahogany and the framing Honduras; but often the whole faces and edges of the doors are veneered. The stall board, shutters, and sashes are shown on Plate 27. Stall boards and sash bars with brass or zinc faces may be procured in great variety, ready manufactured in single lengths of upwards of 30 feet. Brass and zinc sash bars of various design cost from eighteen pence ($^3/_4$ inch sectional length) to ten shillings (5 inch sectional length with hard wood core, iron tongue, and mouldings of hard wood to fix glass) per foot run. Angle bars cost one-half more, and half bars one-third less than whole bars. Plate 29, contains design for chimney piece: the mouldings are given at large. The mirror above is to be fixed in the manner shown; the mouldings are to be of mahogany and the enrichment *papier maché;* the linings may be of deal. The mahogany is to be French polished, the rest of the woodwork being grained maple, satin wood, or as may be preferred: the pedestals and front of closets, round lower part of shop should be grained some dark coloured wood; and the columns being of Mahogany will stand well out if the part behind them is grained some light coloured wood, or finished white or any delicate colour. The doors at the end of the shop must be finished to harmonize with the colour around, but on the subject of decoration we shall hereafter make a few remarks.

The approximate cost of this shop front and the interior decorations and finishings as shown on the drawings, cement and stone being used for the facing of the front, plate glass (British) throughout, Honduras mahogany as mentioned and deal grained, exclusive of the side and end walls and the joisting above the shop, but including the flooring to it, will be £600. A reduction of betwen one and two hundred pounds may be effected by slightly reducing the decoration of the front, using throughout brickwork and cement, and within substituting yellow fir for mahogany, crown instead of plate glass and modifying some of the decoration. The expense would certainly not exceed the sum named, but sufficient details are given to enable any builder to give an accurate estimate after examination of the premises on which the works may be proposed to be executed, so modified to suit the site; as it is impossible to give designs of this description which, from peculiarities of location, can be carried out without some alterations with respect to the space to be occupied. The value of such designs consists in their being *suggestive* of modes of construction and decorations, rather than being suited as a whole to a particular house, a circumstance which can seldom occur. A shop can therefore be erected and fitted up in the style of the design given, although the dimensions may not be precisely adhered to in all respects.

DRAINAGE OF LAND AND BUILDINGS.

Drainage is the art of carrying off all the refuse, decomposing matters and water accumulating on land and in buildings. It also includes irrigation and the supply of water as a powerful means in all cleansing operations. One branch of the science considers the means of collecting the refuse matters and rendering them productive in the shape of *manures*. This is a subject which has only lately received that consideration, which has demonstrated the folly of throwing away in rivers what is so valuable in itself, independently of the evil of polluting the water and the atmosphere around.

Of the paramount importance of drainage operations there can be no doubt. By its means fens and swamps are converted into fertile agricultural land, or fitted for building purposes; fevers, malaria, and agues, before prevalent on them, are diminished or totally cease; health

and cleanliness are promoted; and that contamination, arising from the open ditch or sewer, or from the cesspool, allowing decayed matter to penetrate the soil and rise in gaseous exhalations, is obviated. Where water is allowed to collect, manures do not fertilize the soil, which cannot be pulverized, and the products of the land are consequently unsatisfactory. In spring and autumn the hoar frost constantly prevails, and in summer insects eat up the stock, trees are stunted in their growth, and the grass and vegetation are bad. But the evil effects of inefficient drainage are not confined to country districts. It is emphatically in towns, where manure is collected together, that they especially exist. Of this the ancient Romans were well aware. Their sewers were so extensive that barges could be floated through them — so large indeed that they have been presumed to have been the remains of some gigantic city which existed long before the reign of Tarquin. The great sewer, *cloaca maxima*, is as firm now as when first formed. A wagon laden with hay might pass through parts of it. For twenty-four centuries it has now been in use; and it will probably last for as long a period from the present time. The sewers of London are now the most celebrated in the world. Their importance and the test of their efficiency are thus stated by Dr. Southwood Smith. "If you were to take a map and mark out the districts which are the constant seats of fever in London, as ascertained by the records of the fever hospital, and at the same time compare it with a map of the sewers of the metropolis, you would be able to mark out invariably and with absolute certainty where the sewers are, and where they are not, by observing where fever exists; so that we can always tell where the Commissioners of Sewers have not been at work by the track of a fever." Considering that there are five million tons of drainage to dispose of from London every year, the above statement is by no means surprising. We can thus also easily comprehend why the drainage of London should be a problem of such exceeding difficulty, and the Thames, into which the sewers are conducted, the most polluted of all rivers. At it is, however, London is the best drained city, considering its size, in the world, and Paris, abounding in smells, can bear no comparison with it. What London was about 1290 we may learn from Stow. Of the Fleet stream, now a sewer, formerly alluded to as "choice fountains of water, sweet, wholesome and clear," the monks of the monastery of white Friars "complained to the King and Parliament that the putrid exhalations arising from it were so powerful as to overcome all the frankincense burnt at their altars during divine service and even occasioned the deaths of many of the brethren." It was indeed so large a stream as to admit of the passage of "ten or twelve ships at once, laden with merchandise," up to old Bourne (now Holborn) Bridge. When we come to consider the difficulties involved in the efficient drainage of so immense a city, it is surprising how, with all its faults, and they are many and great, so much should have been done; and there can be no doubt that, from the earnest efforts which are now being made, the system will be considerably perfected, so as to render London one of the most healthy, as it is the most densely populated, capital in the world. We shall first make some brief observations on the drainage of land, before proceeding to the consideration of that of towns and buildings. The supply of water will be treated in a different article.

The drainage of land may be subdivided under three headings; first, that of land flooded, or marshy, and rendered fit for cultivation and building by means of embankments, canals, etc.; second, land inundated by springs rising from strata below the surface; third, land lying flat, or formed in hollows, and saturated with rains, dews, etc., which are not sufficiently carried off by evaporation and cannot sink through the soil, owing to the impervious character of the underlaying strata. A *good drained soil*, we may remark, is one, in which the water does not remain in the spaces between the loose particles of the earth, but, after filling and saturating these particles, sinks through and passes away. An *undrained soil* is when the passages continue full through the water being prevented passing away from want of channels, or by reason of an impermeable substratum, the soil thus continuing inundated. The removal of this by means

of proper channels, either open or closed, and laid, with a sufficient slope or fall, constitutes the art of drainage. There may not, on the other hand, be a sufficient supply of water. Irrigation is the application of it to tracts of land, and its proper supply and regulation comes within drainage operations.

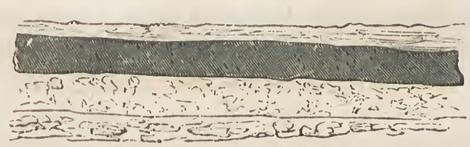
With respect to the first divison of drainage, embanking is necessary if the surface of the ground is below the level of the sea or river adjoining. Channels or drains are cut, and, as the water in them is below the level of the water into which they are required to discharge, it must be raised by means of pumps and buckets. The application of steam by Rennie, in 1820, to the working of a large scoop wheel for draining a fen near Ely is one of the most valuable advances in mechanical draining. In England a vast quantity of fenny and marshy land has been reclaimed and rendered available for agricultural purposes. A company thus rendered productive the district known as the Bedford level, before comparatively useless. In Switzerland many marshes and even lakes have been made dry by means of tunnels cut through the solid rock and thus effectually draining them. The Romans, when in this island, reclaimed the Romsey marshes; and we find in the ordinances of Henry III. "that all the lands in the said marsh be kept and retained against the violence of the sea, and the floods of the fresh waters, with banks and sewers." A modern successful work is the drainage of the Lake of Haarlem in Holland, by which 800,000,000 tons of water in a space of 45,230 acres of an average depth of 14 feet are pumped out by means of steam power. Below a rich alluvial soil, admirably fitted for agricultural purposes, was found. A superabundance of water may often be got rid of by the process of tapping, and thus communicating with a lower permeable stratum, the openings being termed *drain wells.* The general process adopted in instances of land below the level of adjoining waters is, first to cut channels at intervals to collect the water and conduct it to a main drain parallel to the adjoining waters, the passage into them being regulated by sluices, or the water is raised by pumps. The earth removed from the drains is cast up at the sides, thus increasing their depth and forming roads on either side.

Where land is flooded by springs, the first proceeding is to discover the readiest channels by which the water can be carried off. One drain properly contrived may thus be made to dispose of the water before it inundates the land; for it is useless to cut passages through the fields, allowing all the water to soak into the soil. If the water is spread all over the soil, small drains are effective running into main drains; but when a large drain will serve the purpose, it is preferable to smaller ones, as these latter do not last so long and are less easily kept efficient. The system of drainage introduced by Mr. Elkington in 1764, was a great advance over what had before been done. His method was, "1st, finding out the *main spring,* or cause of the mischief; 2nd, taking the level of that spring and ascertaining its subterraneous bearings; 3rd, making use of the augur to reach or tap the spring, when the depth of the drain is not sufficient for the purpose." This last process is useful only when the spring is supplied from a high level; but it will be instructive to many of our readers to learn the nature of the proceedings which led to the adoption of Elkington's system. "In order to drain a field, he cut a trench about four or five feet deep, a little below the upper side of a bog, or where the wetness began to make its appearance; and, after proceeding with it so far in this direction and at this depth, he found it did not reach the main body of subjacent water from which the evil proceeded. On discovering this he was at a loss how to proceed. At this time, while he was considering what was next to be done, one of his servants accidentally came to the field, where the drain was making, with an iron crow or bar, which the farmers in that country use for making holes for fixing their sheep hurdles. Mr. Elkington having a suspicion that his drain was not deep enough, and a desire to know what kind of strata lay at the bottom of it, took the iron bar from the servant and, after having forced it down four feet below the bottom of the trench, in pulling it out, to his astonishment, a great quantity of water burst up through the hole he had just made and ran down

the drain. This at once led him to the knowledge of wetness being often produced by water confined further below the surface of the ground than it was possible for the usual depth of drains to reach, and induced him to think of employing an augur as a proper instrument in such cases." Numerous holes bored through the bottoms of drains will cause water either to rise up and be thus carried off, or to sink through them according to the situation of the porous stratum.

Water, lying on flat imperious soils and in too great quantity to be carried of by evaporation, often necessitates very laborious and expensive operations for its removal, owing to the numerous drains which are requisite. We have first to consider the nature of the soil, second the arrangement of the drains, and third their construction.

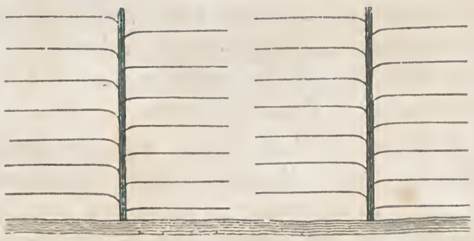
Clays are considered retentive of water and impermeable; sands and limes porous. Sandy soils and those of lime do not support vegetation as argillaceous earth or clay. "Land of the greatest fetility contains argillaceous earth and other disintegrated minerals, with chalk and sand in such proportion as to give free access to air and moisture." Deep drains and surface or *shallow* drains will be adopted in accordance with the character of the strata, a knowledge of the section of which should always precede the commencement of drainage works. If there is a rocky substratum, surface drainage will be adopted; if the ground is boggy and the surface below the level of the adjacent waters, we must bore to a lower stratum. There continually occurs a layer of light earth over a substratum of clay, and, as the water is prevented escaping, the soil often becomes filled like a sponge. If, as in the first cut, the porous stratum lies directly under the surface, the retentive next to it, and a mixed stratum lowest, the drains must be made



with reference to the porous soil alone, or else quite through the clay, which latter will be most effectual. If however, as in the next cut, where the clay is above the porous stratum, it will be essential to cut the drains through the clay and the porous stratum also, if it be not too thick; otherwise numerous small drains must be formed to carry off the wet from the clay. Borings to the depth of six or eight feet should be made to obtain a proper knowledge of the character of soils. In the Instructions of the Government for providing Cemeteries is some valuable information on soils and drainage, and, as they are included in this work, we abstract some brief particulars. "Porous soils with a good natural drainage require little outlay, except what may be requisite to ensure dryness of surface and of the roads and pathways. When denser soils, especially loams and clays are selected, works of drainage are required, not only to improve the character of the soil, but to prevent water accumulating in the graves and vaults. Loose soils may be sufficiently drained by small drain tiles, laid below the bottom of the graves. These might be united into branches, laid at a suitable depth beneath the paths and roads, and so to the outlet, which should be carried to such a point in the natural outfall, that no injury may take place from the pollution of water used for domestic purposes. The distance of the lines of drain pipes from each other would vary with the nature of the soil. They would have to be placed closer together in dense than in porous soils. The distance might advantageously be fixed at some multiple of the length or breadth of the grave spaces. In cases where, from local circumstances, no proper fall for drainage can be obtained, the ground might be drained by pumping, as at a cemetery at Hull. When clay soils are used, there is no way of draining the ground satisfactorily except by deep drainage below the lowest point of the grave, and by connecting each grave with a drain. This has been effected in clay cemeteries by carrying a deep sewer through the ground and beginning the interments close by the line of the sewer. Some broken stones or a

tile drain is laid in the bottom of the grave so as to leave a passage for the water to the sewer. The layers of stone, or the tiles in the first series of graves, are again connected with similar layers of stones or tiles in the second series, and so on with the third and succeeding series; and in this way the surface water, which would otherwise have accumulated in the graves, is removed. The passage of air through the broken clay soil filling the grave is facilitated and the soil is gradually improved."

The arrangement of drains will of course be modified according to the levels of the ground; the method for high tracts, where there is too little water, differing from that for low tracts containing a superabundance. Ground is not often found perfectly level, and the first proceeding, when it is nearly so, is to ascertain the greatest inclination and its direction. If the soil be toterably uniform in character and the ground fairly level, the main drains may be as shown by the thick lines and the minor drains as the thin ones; but if soils of various powers of retention are on the surface, the drains must be planned with reference to the line of junction of the soils. The drains should lie as near as possible at right angles to the inclination of the surface of the ground and be in straight lines, without sudden turns, bending gradually where requisite. Their number will depend on the flatness of the surface and the stiffness of the soil. A great fall is not desirable; and the course of every drain should be oblique to that of the water. The outlets are often made into the ditch bounding a field. They should be few in number and have a projecting piece of wood or stone, about two feet above the bottom of the ditch, so as to prevent the constant washing of soil into it. The drain should not enter the ditch at right angles, but be brought down in a slanting direction; and it is obvious that it will be always desirable to keep the water in the ditch below the level of the exit of the drain.



On the depth of drains we have before remarked. The necessity for a fall will considerably modify it under certain circumstances. If the drains are 20 feet apart, 1 foot fall in 300 will be found sufficient, for a great fall is to be carefully avoided. The practice of carrying a drain directly down a steep slope, as is sometimes done, side drains running into it, is hardly to be commended. Of course the depth of drains should be such that the plough may not reach or the feet of cattle destroy them if in pasture land. Where there is a thin layer of loose soil over clay, the drains may be about two feet in the latter.

Open drains are good only for surface drainage. If of any depth to drain the substratum, they should be covered in; or, by reason of their sloping sides, they will occupy too much space. They are also constantly exposed to injury from the destruction of their banks; and in towns the evaporation of the stagnant water is extremely deleterious. The constant repair and trouble requisite are sufficient reasons against them. In land planted with forest trees, open drains are however preferable, as the roots of the trees sooner or later destroy covered ones.

Covered drains admit of great variety in their construction. The first cut, showing simple layers of stones, is perhaps the cheapest, but it is liable to become choked. The next is preferable if the stones can be easily procured; the tiles in the third may be perforated as shown in the smaller cut. Slate may be substituted for the flat tile, the utility of which consist in preventing

the semi-circular top from indenting the soil, and care must be taken not to let the joints correspond. The ordinary draining tile, which is merely a flat tile bent in the form of a semi-cylinder by a machine, is good for surface drainage. However ingenious the above contrivances, there can be no doubt that, for permanence, completeness and economy, tile piping is by far the preferable mode of draining.

It is not liable to injury from vermin, is laid with great rapidity and retains permanently its position in the soil. Of course trees and vegetation will disturb and interfere with its action, and care must therefore be taken not to lay drains where their efficiency is likely to be destroyed. Their depth and distance apart will be regulated by the nature of the soil and its position, but depths of two to three feet, and distances of eighteen to twenty-four are about the general dimensions. The utmost care must be taken to prevent the pipes slipping apart and accurately to fit them together. We may mention that for drain tiles of an inner diameter of 3 or 4 inches the breadth of the flat tile or sole is about 7 inches, the length varying from 12 to 15 inches. The soles cost about 10 shillings per thousand and the tiles twice as much. Piping two inches diameter and fifteen inches long may be had for about 16 shillings per thousand; and the following statement of the comparative cost of drains per acre is given by Mr. Stephens, the drains being considered to be 30 inches deep and 15 feet apart.

Loose stone drains	£ 8 „ 14 „ 9.
Sole and tile drains	7 „ 10 „ 8.
Pipe tiles drains	5 „ 8 „ 9.

We conclude our observations on the drainage of land with a table compiled by Mr. Dempsey and given in his able and interesting treatise on drainage.

DESCRIPTION OF SOILS.	Distance of Drains apart.	Depth of Drains.	Cost of cutting and filling per acre.	Number of Drain Pipes 12 in. long per acre.	Cost of drain tiles per acre, at 30s per 1,000.	Total cost per acre.
Compact or heavy Soils.	Feet.	Feet. in.	£ s d		£ s d	£ s d
Compact, tenacious, gravelly clay	15	2 „ 6	3 „ 13 „ 4	2905	4 „ 7 „ 2	8 „ 0 „ 6
Stiff adhesive clay . .	16½	2 „ 6	3 „ 3 „ 4	2640	3 „ 19 „ 2	7 „ 2 „ 6
Friable clay	18	2 „ 9	2 „ 15 „ 1½	2120	3 „ 12 „ 7	6 „ 7 „ 8
Free soft clay . . .	21	2 „ 9	2 „ 2 „ 0	2076	3 „ 2 „ 3	5 „ 4 „ 3
Medium Soils.						
Clayey loam	22	3 „ 0	2 „ 10 „ 0	1980	2 „ 19 „ 5	5 „ 9 „ 5
Marly loam	24	3 „ 0	2 „ 1 „ 3	1814	2 „ 14 „ 5½	4 „ 15 „ 8
Gravelly loam . . .	27	3 „ 3	2 „ 17 „ 2	1613	2 „ 8 „ 4½	5 „ 5 „ 6½
Friable loam	30	3 „ 3	2 „ 4 „ 0	1452	2 „ 3 „ 6½	4 „ 7 „ 6½
Porous or light Soils.						
Light gravelly loam .	33	3 „ 6	2 „ 16 „ 8	1320	1 „ 19 „ 7	4 „ 16 „ 3
Light marly loam . .	36	3 „ 9	2 „ 9 „ 4	1209	1 „ 16 „ 3	4 „ 5 „ 7
Sandy loam	39	4 „ 0	1 „ 19 „ 8	1117	1 „ 13 „ 6	3 „ 3 „ 2
Soft light loam . . .	42	4 „ 0	1 „ 16 „ 9	1037	1 „ 11 „ 1½	3 „ 7 „ 10½
Sandy soil	45	4 „ 0	1 „ 14 „ 5	974	1 „ 9 „ 2½	3 „ 3 „ 7½
Light gravelly sand .	49½	4 „ 3	2 „ 5 „ 0	880	1 „ 7 „ 4½	3 „ 12 „ 10
Deep do. do. .	55	4 „ 3	1 „ 16 „ 0	792	1 „ 3 „ 9	2 „ 19 „ 9
Coarse do. do. .	60	4 „ 6	2 „ 4 „ 0	726	1 „ 1 „ 9	3 „ 5 „ 9
Loose do. do. .	66	4 „ 6	1 „ 13 „ 4	660	19 „ 9½	2 „ 13 „ 1½

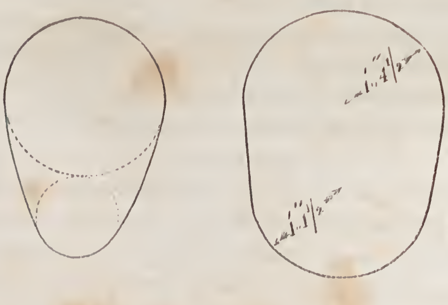
Having given an outline of the mode of draining districts and land, we shall next proceed to the consideration of that of towns and buildings. The old idea that a river adjoining a town should be converted into its main sewer is being gradually given up, owing to the experience of

the contamination of the water and the atmosphere thus caused, and the deterioration of the health of those who reside near the banks, as well as the discovery of the folly of throwing away that refuse matter which can be made so productive in the shape of manure. Drainage matter carried into a river not only pollutes the water and renders it unfit for use, but being often spread over the banks and brought back again by the tide after being carried off, the air around is thoroughly deteriorated. The water too, entering the sewers, stops their action and drives back the decaying matters. If the drains to the houses are inefficiently trapped, the consequence is that the ammonia in the substances and fluids which should have been at once carried off is disengaged and mixes with the air in the form of carbonate of ammonia, rising and spreading through dwellings and producing very hurtful effects. It is also well understood that this disengagement lessens the value of the sewage as manure and tends to cause decay in buildings. The subject is of such paramount importance that we shall give Liebig's statement of the means which may be taken to obviate the consequences named. "Gypsum, chloride of calcium, sulphuric and muriatic acids and superphosphate of lime are substances of very low price, and if they were added to urine until the latter lost its alkalinity, the ammonia would be converted into salts, which would have no further tendency to volatilize. When a basin, filled with concentrated muriatic acid, is placed in a common necessary, so that its surface is in free communication with the vapours issuing from below, it becomes filled after a few days with crystals of muriate of ammonia. The ammonia, the presence of which the organs of smell amply testify, combines with the muriatic acid, looses entirely its volatility, and thick clouds or fumes of the salt newly formed hang over the basin. In stables the same may be seen. The ammonia, escaping in this manner, is not only lost, as far as our vegetation is concerned, but it works also a slow though not less certain destruction of the walls of the building. For when in contact with the lime of the mortar, it is converted into nitric acid, which gradually dissolves the lime. The injury thus done to a building by the formation of soluble nitrates has received in Germany a special name — *salpeterfrass* (production of soluble nitrate of lime). The ammonia emitted from stables and necessaries is always in combination with carbonic acid. Carbonate of ammonia and sulphate of lime (gypsum) cannot be brought together at common temperatures without mutual decomposition. The ammonia enters into combination with the sulphuric acid, and the carbonic acid with the lime, forming compounds destitute of volatility, and consequently of smell. Now if we strew the floors of our stables from time to time with common gypsum, they will loose all their offensive smell and none of the ammonia can be lost, but will be retained in a condition serviceable as manure."

The general plan of the drainage of towns will of course be varied according to the situations and the surrounding features. In towns lying low, the drainage may be brought to two or more situations according to its quantity and be then carted away. Towns lying high may have their sewage carried off at once to some distance. As above shown, the collection of refuse matter in receptacles and the carting of it off may be effected without the least injury to the health of those residing near, besides preserving those qualities which render it valuable as a manure. The street debris should be swept into and carried off by the sewers, notwithstanding this has been objected to as deteriorating from the value of manure, its proportion being usually too small to effect it; and the disgusting process of carrying it off above ground is sufficient to recommend the use of the sewer. The size of main sewers is settled according to the quantity of sewage and the fall that can be obtained. They are commonly made too large. The Fleet sewer in London is 18 ft. 6 in. by 12 ft. at the mouth. The Westminster sewers are of the form shown on page 262. in the Glossary of The Builder's Practical Director; the largest are 5 ft. 6 in. high and 3 ft. wide. The Holborn and Finsbury Commission required that "every sewer which may receive the sewage from streets and places containing more than two hundred houses shall be of an oval form, five feet in height and three feet in width in the clear, the invert thereof

to be worked one brick in substance, and the springing walls thereof to be worked one brick and a half in substance and bonded, and the crown thereof one brick in substance in two separate half bricks." Branch sewers receiving sewage from less than two hundred houses were required to be 4 ft. 6 in. high, by 2 ft. 6 in. wide. In the City the smallest size in a large street is 4 ft. 6 in. by 2 ft. 6 in. We may get a rough idea of the proper size of a sewer by considering each house as containing on the average five persons, and that the waste matter from each individual to be disposed of is twenty gallons. The rain fall may be taken at two inches per diem; and, as the drainage is not uniform, provision should be made for carrying it off in two hours, thus allowing for the effects of storms. Allowing also for the increase of the neighbourhood, if we divide the aggregate sum, reduced into cubic feet, by 120, for the quantity per minute, we can then proportion the size of the pipes to it by simply ascertaining the diameter requisite for the discharge of the water. The size of the sewer need not be uniform throughout, but be diminished gradually from the mouth to where it is least filled. The advantage of having a sewer of small dimensions is the decrease of friction owing to the concentration of the water, and any substance getting into a small sewer will probably, by blocking it up, cause such an accumulation of water that the pressure at length forces it on with great rapidity; while in a large sewer, the object will be left stationary, owing to the water having plenty of space to pass, and thus an accumulation of matter gradually takes place.

With respect to the form of sewers, the elliptic is the strongest; as in a sewer the vertical pressure is the greatest, the top and the sides must be of great strength, the latter being also dependent on the characteristics of the soil. The bottom of the sewer, must be firm enough to react against the sides and to withstand the resistance of the soil beneath to the weight of the sewer. An elliptical form, with its greatest length in a vertical direction, is thus found to be the most preferable shape. The figure in the margin is that recommended by Mr. Dempsey, and the reduced radius of the curved bottom prevents as much as possible retardation from friction. The diameter of the lower circle equals 1, that of the upper 2, the height of the sewer 3, and the radius of the side arcs the same. The second diagram exhibits the form adopted in the Holborn District.



The Metropolitan Boards have decided that a fall of half an inch in 10 feet, or 1 in 240, is sufficient. The Holborn and Finsbury regulations required that "the inclination be not less than $^1/_4$ inch to every 10 feet in length, and as much more as circumstances will admit in those portions that are in a straight line, and double that fall in portions that are curved." Curves considerably modify the rapidity of the passage of sewage. An equal quatity of water running along equal lengths of sewers with similar falls are found by Mr. Roe to be discharged as follows; —

Along a straight line	90 seconds.
With a true curve	100 „
With a turn at right angles . . .	140 „

A greater fall should be given to the curved than to the straight parts of the sewers; and Mr. Roe recommends that the curves be of not less radius than twenty feet. The construction of sewers will be generally modified by the character of the soil in which they are placed; many which might be safely built in $4^1/_2$ in. work in some soils requiring in others considerably greater strength. The form of sewer recommended by Mr. Dempsey, built in half brick work at a depth of about 10 feet, is estimated by him to cost as follows;

8*

	s	d	
4′ „ 0″ >< 2′ „ 8″	10 „	0	per foot run.
3′ „ 6″ >< 2′ „ 6″	8 „	6	„ „ „
3′ „ 0″ >< 2′ „ 0″	7 „	0	„ „ „
2′ „ 6″ >< 1′ „ 8″	5 „	6	„ „ „
2′ „ 0″ >< 1′ „ 4″	4 „	6	„ „ „

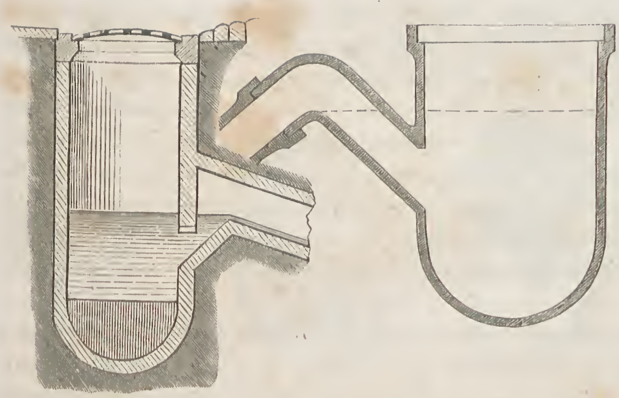
The following is a Specification of works executed at Cambridge: — "Construct a cylindrical sewer with sound, well burnt, bevel-shaped bricks, carefully bedded in mortar with thin joints. All the joints are to be well flushed, and the bricks are to be laid in a good, sound, workmanlike manner and to butt each other. If any parts of the sewer should pass through a stratum of gravel, then the bricks forming the invert must be bedded in cement. All the bricks used with cement are to be previously well soaked in clean water. The Roman cement is to be of the best quality, mixed in the proportion of one measure of clean washed sand to one of cement. The cement when once set is not to be remixed. The mortar is to be formed in the proportion of one part of well-burnt clunch lime, fresh from the kiln, to three parts of clean sharp sand, well beaten and incorporated. The Commissioners will provide Smith's glazed stone syphon gully traps, 18 inches diameter, which the contractor is to joint with pure cement and to fix in $4^1/_2$ inch brickwork on proper footings. Fix the iron gratings which the Commissioners will provide. Form and lay in lateral drains of 6 inch glazed stone pipes, jointed with mortar, and carefully connect them with the trap and sewer. Not more than thirty feet lineal of the bottom, or invert courses of the sewer shall be laid on at one time, and this is to be left uncovered until inspected by the Surveyor, who on approving thereof will authorize the centre to be fixed and the arch to be turned and keyed."

When the diameter of the sewer is not required to be above eighteen inches, glazed stoneware tubes may be adopted. They are more easily and rapidly laid than brick sewers; there is less excavation and altogether more economy; but when their diameter exceeds eighteen inches, they are rarely of true form and perfectly cylindrical, and there is much difficulty in laying them properly. Egg shaped tubes 15 >< 9 inches may be procured for 2*s* „ 3*d*, and 20 >< 12 inches 3*s* „ 6*d* per foot run. Mr. Dempsey states the following as the average cost of supplying and laying pipe sewers in London:

	s	d	
4 inch	— „	5	per foot run.
9 „	1 „	3	„ „ „
12 „	3 „	3	„ „ „
15 „	3 „	10	„ „ „
18 „	6 „	0	„ „ „

The bottom of the trenches should be moulded to the shape of the sewers and holes cut for the sockets. If clay abounds, an impervious coating 9″ thick may be formed round the sewers. Means of access are requisite to large sewers for cleansing and other purposes. This is now obtained by the substitution of side entrances for the manholes formerly used, thus avoiding the objectionable breaking up of the streets. A square well is constructed in brickwork down to about two feet from the bottom of the sewer. A hinged cover, or trap door with a lock, set in flagstone, opens from the street into the well, and handirons are provided to get down. The cover is kept open when required by a self-acting catch, and an iron grating, which admits light and air, rises to its place and prevents people falling in. One side entrance is generally provided to every six hundred feet of sewer.

Gully traps with shoots are provided to conduct the surface drainage of streets into sewers. The diagram shows the form ordinarily adopted. The mud at the bottom is cleared out



monthly, or as often as requisite, and the curtain wall, or dipping valve, prevents the escape from the sewers of the gases and putrid smells arising from the fermentation and decay of the refuse matters. The water sometimes becomes evaporated, but this can easily be remedied. The second diagram shows a section of a gully trap manufactured by Mr. Doulton. A stoneware or iron grating may be placed at the top and the cost, according to size, is from 7*s* „ 6*d* to 18 shillings.

The ventilation of sewers is a matter of considerable difficulty. An explosive mixture is generated in them rendering it dangerous to enter with lamps. Some Commissioners have forbidden the trapping of gully holes and require them to be kept open. Near such a gully hole fever will be found very liable to occur, and a butcher's shop could not be kept there. The Metropolis Local Management Act requires *all* gully holes to be trapped. Mr. Fuller proposed to have a furnace with a lofty chimney erected near the highest part of every main sewer, and so arranged that the fire could be supplied with the air essential for combustion from the sewer only. The fires of manufactories might thus be made to aid ventilation.

Flushing is a mode of cleansing sewers by retaining water by flushing gates and then permitting it suddenly to rush through the sewer, sweeping everything before it. One evil however of it is that it drives up the gases so violently that, unless the gully holes and drains leading into dwellings are very carefully trapped, they escape and cause discomfort and illness. We may here mention that to present a rising tide entering a sewer delivering into a river, valves or heavy flaps are used, and men, called *flap-keepers*, are employed to open the flaps at low water to allow the sewage to escape.

We come next to the drainage of the refuse matter from houses which is led into the sewers.

First with respect to the levels, the lowest floors of houses should be at least four feet above the level of the commencement of the invert of the sewer. If they are otherwise, the houses will be constantly liable to be flooded when the sewers are unusually filled through heavy rains, or when flushing operations are going on.

The Westminster Commissioners required the bottoms of drains, at their junction with the sewer, to be twelve inches above the bottom of it, and that they should have a fall of at least one quarter inch to the foot. This is fifteen inches in a length of sixty feet; adding thirteen inches for the height of the drain and brick arch over it, eight inches for the depth of the ground and paving over the upper end of the drain, and twelve inches between its lower end and the bottom of the sewer, we have the fall of four feet. The Holborn and Finsbury Commission required a height of two feet between the bottom of the sewer and that of the drain.

The junctions, and about three feet of the drain, were made by the Commissioners to prevent injury to the sewers.

The New Act for the Local Management of the Metropolis contains a section the object of which is to compel owners of houses, whether built before or after the passing of the Act, to construct drains into the sewer (if one exists within 100 feet), properly syphoned, together with all other requisites for draining the houses.

With respect to the arrangement of drains in country districts, where there are no sewers, they will be best carried some distance from the house and connected with a manure tank, so constructed that the liquid portion may be separated from the solid. One is shown at Page 96,

of the first series of this Work. In towns the drains will be carried by the most direct route into the nearest sewer. The Metropolitan Commission of Sewers introduced in 1849, a very valuable improvement. Instead of carrying the drainage through the house into the main sewer in the centre of the street, causing, oftentimes, when there was the least derangement, a disagreeable smell in the rooms and passages, besides necessitating the disturbance of the inmates by taking up the flooring for repairs, the sewage was conveyed at once out of the back of the house, under the yard or garden, in smaller drains with a greater fall, consequent in the shorter lengths that were required when the drain had to be constructed through the total depth of the house. The necessity of removing the street paving and stopping the traffic was also thus obviated.

Drains, like sewers, should not be constructed of great size, on account of the unnecessary increase of friction and the fact that semi-liquid masses flow rapidly in proportion to the narrowness of surface of the drains. Pipes of 4 or 5 inches internal diameter will be found ample for moderate sized houses, and the largest will not require pipes above 6 inches: factories, where there is a great quantity of water to be disposed of, may have them from 9 to 15 inches.

Pipes up to 6 inches diameter are procurable in lengths of 2 feet, above this in 3 feet lengths.

A fall of a quarter of an inch to a foot is the least that should be given; 1 in 20 or 30 is good; but it can hardly be too great.

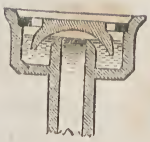
Brick drains were formerly in exclusive use, 9 or 4½ inches thick; thinner than the latter they cannot be with our present bricks. There is consequently much more excavation requisite than with pipe drains which are now justly preferred. Iron is liable to corrosion, and brick drains are not impermeable. The stoneware is thus superior; and if glazed, with carefully formed sockets, and of perfectly cylindrical and uniform bore, it is difficult to discover a preferable substitute, especially as stoneware are not like brick drains liable to destruction from vermin.

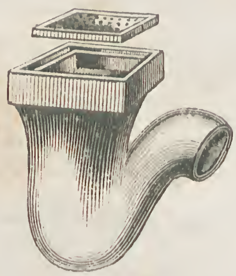
The Westminster Commission charged — "for cutting through the springing wall of a sewer, putting in a cemented brick ring and soundly underpenning the wall round the same, the sum of 10*s* „ 6*d* for each opening. For building a length of 3′ 4″ of 9 in. barrel drain, with proper York keel stone, sound stock bricks and blue lias lime mortar, the sum of 10*s* „ 6*d* for each such length of drain. For the same length of 12 in. barrel drain, 12*s* „ 6*d*; the digging to be done at the expense of the party requiring the drain." Rendering the lower part of the drains inside and the upper part outside with cement is a desirable process, and costs about two pence per foot super; and they may be jointed with punned clay, lias lime or cement. Tubular drains cost, if 4 inches internal diameter 5*d*, 6 inch 7*d*, 9 inch 1*s* „ 1*d*, 12 inch 1*s* „ 10*d*, exclusive of digging and setting. Bends for the same drains cost from 1*s* „ 9*d* to 5*s* „ 6*d*; and junctions 1*s* „ 6*d* to 5*s* „ 6*d*; if double rather more. Moveable covers to the angles are desirable; and there has been lately patented by Mr. Jennings drain pipes admitting of being uncovered throughout their length, and thus presenting facilities for the detection of the cause of stoppage and for general repairs. His contrivance is certainly very admirable.

The drains must be carefully connected with the sewer. If they are of brick a cement ring is turned at the junction, with sometimes a socket of stoneware. If the sewer is of stoneware it is provided with sockets into which the drains fit; and these sockets are usually plugged with wood till required. The best blue lias cement should be used at these junctions. As before remarked, the level of the drain should be kept as high as possible above the bottom of the sewer; and the drain should not be connected with it at right angles, but be laid with a curve of a radius of 8 or 10 feet. Brick funnels are often constructed to receive the feet of rain water pipes and the drains are connected with them.

The prevention of the ascent of deleterious gases in drains by trapping is a matter requiring the utmost care and attention. The action of traps depends on the formation of what is

termed a *water-lute*, and a vast number of ingenious varities have been contrived. Hayward's traps and grates are good. Some prefer them fixed, but if moveable they admit of being cleaned out. The first diagram in the margin represents a trap of metal; the grating may be unscrewed, together with the inverted cup, acting as a dipping valve; and the whole is fixed flush with the stonework of the sink for which it is intended. Simplicity and permanence of action, without constant liability of derangement, are the chief requisites of traps; and these are promoted by the one shown next, which, with the yard trap following it, is made by Doulton. These stoneware contrivances are cheap, simple, and efficient; and an enamelled stoneware closet-pan, with syphon tap screwed on, may be had as low as 5*s* 6*d*. Of water closets we have before spoken, and explained in a prior portion of the work their mode of action; and the open cesspool is a contrivance which is now deemed one of the most conclusive proofs of the ignorance of our forefathers. The water closet should be as high as possible and always above ground to obtain a good fall for the drain. It should also be near the sewer, and all the waste water from the sinks, etc., should be made to flush it. If the supply of water is constant, a mere tap will suffice to cleanse the trap; but when the supply is intermittent a cistern must be provided. If one of the stoneware traps is used, and 4 feet of 4 inch vertical pipe is required to the drain, costing 1*s* 8*d*, the labour and materials for fixing at 2*s* 6*d*, give a total of 9*s* 8*d* for which a water closet apparatus may be had. A sink, with proper trapped fittings, will cost about 14*s*; and of the cost of drains we have already indicated sufficient to form a basis for calculation. For the subsoil drainage of a house there is no occasion to provide. Sound construction will keep a basement dry, provided the sewage and rain water are carried into the sewer; and the waters of surrounding lands must be cut off in accordance with the principles laid down in our observations on that subject, before they can reach and innundate towns.





The following specifications of ordinary drainage works constantly required will appropriately conclude this article.

Brick drains. Nine inch barrel drains where shown on Plan to conduct water and soil into cesspool (or main sewer); to be well and properly trapped with stone or strong slate at the shoe of each down pipe from the roof; half brick rim; the lower half inside and the upper half outside to be rendered in cement, and the pipes are to be made good to the drains in cement. The fall to be 3 inches in 10 feet. This will cost, exclusive of digging, about one shilling and four pence per foot run in mortar. 12 inch drains may have 4 inch bottoms and 9 inch arch over. 15 inch drain should have one brick rims all round. These latter, will cost, if rendered in cement as above, about four shillings and sixpence per foot run built in mortar, exclusive of digging. Weeping drains may have 1/2 brick rims two courses high, with pantile bottoms and be covered with brick flat.

Cesspools. Form cesspool 6 feet clear diameter and 8 feet deep, lined with 9 inch brickwork, paved with half-brick, and domed over in 9 inch work, all in mortar, and to have a circular manhole carefully formed, 2 feet in diameter, with 4 inch York stone tooled cover and strong wrought iron flush ring, bolt and screw nut, let through stone and run with lead.

Cesspools to feet of water pipes 14 inches square and 2 feet deep; to gratings over 9 inch drains 14 inches square; and to 14 inch drains 18 inches spuare; all to be 1 foot deeper than the bottom of drains, and lined with pure Roman cement 1/2" thick.

Cesspools to stables 9 inches square lined with cement; properly connect 4 inch drains with them; form rounded gutter with bricks on edge, falling towards gratings above cesspools; and cover each cesspool with 2 inch York cover stone, 1 foot square, rebated for cast iron grating, 6 inches square.

Tank. Construct a tank to receive water through the drains from the roof. It may be circular or square, say 9 feet square and deep, to be built in 9 inch work, with 9 inch invert and dome, all to be executed in cement, and the sides and bottom rendered with pure cement $1^1/_4$ inch thick. Provide 4 inch tooled York cover to opening, 2 feet 6 in. diameter, with flush ring complete.

Glazed Drain Pipes. Glazed stoneware tubular drains, with socket joints and proper bends, junctions, double junctions, elbows and traps, to be 2 feet lengths and 5 inches diameter in the clear within, laid to a fall of 2 inches in 10 feet. The sockets to be at least 3 inches in depth to take smaller ends; and the piping generally to be well burnt, sound, free from cracks and defects and perfectly concentric in section. Joint the pipes with cement or well tempered clay. Provide proper glazed stoneware W. C. pans, syphon trap in stoneware to sink, and similar yard gully and trap, or yard gully with funnel top and trap. Properly connect down pipes from roof with drains and provide syphon traps. Lowe's patent stench trap, $9'' \times 5^1/_2''$, may be substituted for those in the yards, properly connected with the drains. Haywood's traps and grates are good, fixed in dished stones for surface water. Drains to be laid towards sewer with a curve of a radius of 8 or 10 feet. Brick funnels may be used at the feet of rain water pipes. Plain earthenware pipes may be used for the soil and glazed for the water.

Glazed stoneware Main Sewer of socket jointed, egg shaped pipes of the diameter of 15 inches inside, with proper connecting sockets for drains, and all necessary bends, junctions etc.; the joints to be well stopped with the best Portland cement. Stoneware gully traps 15 inches diameter, costing 15 shillings each.

DESIGN FOR A CHAPEL.

PLATES 30. to 37.

Before describing this design we shall make a few observations on the points to be attended to in description of buildings. It is but too common to overcrowd congregations, instead of accomodating them, in churches and chapels; and most of the modern Gothic edifices are suited rather to the requirements of Roman Catholics than to the more simple worship of Protestantism. The columns obstruct sight and hearing; and our architects have shown the difficulty of treating the galleries now desired, their general effect being to spoil the interior effect. Even when there are no galleries, the pillars separating the nave from the aisles are retained; and few have carried out the idea of one large open space, without any obstructions to the view of the officiating clergyman and the distinct hearing of the service and sermon.

An appropriate arrangement of the entrances, so as to distribute the congregation in separate streams and avoid crowding, is of great importance; and where there are galleries, access should be provided from the body of the church or chapel to them for the convenience of those who attend the communion. The entrance to vaults should be from outside the edifice. The character of the site too must be taken into consideration, with respect to the nature of the soil and its appropriateness for foundations, and the proximity of buildings tending to obstruct the light, or which may be hereafter erected, perhaps against the walls of the edifice, blocking up the windows.

The description of the adjacent buildings is also to be inquired into; as factories and other structures in which there may be a great noise during the week would tend to disturb congregations who may meet on other days than Sundays. Nuisances are caused by the carrying on of some trades, all of which circumstances should receive due consideration prior to the selection of a site. Places of worship also must not be placed in localities too removed from the people who are anticipated to frequent them; otherwise, when the weather is at all inclement, they will be liable to be deserted. Sir Christopher Wren, whose experience in the erection of churches was, as is sufficiently well known, of the most extensive description, makes the following sensible remarks. "As to the situation of churches, I should propose they be brought as forward as possible into the larger and more open streets, not in obscure lanes, and where coaches will be much obstructed in the passage. Nor are we, I think, too nicely to observe east or west in the position, unless it falls out properly; such fronts as shall happen to lie most open to view should be adorned with porticoes, both for beauty and convenience; which, together with handsome spires and lanterns, rising in good proportion above the neighbouring houses (of which I have given several examples in the city of different forms), may be of sufficient ornament to the town, without a great expense for enriching the outward walls of the churches, in which plainess and duration ought principally, if not wholly, to be studied."

With respect to the size of places of worship, it will be regulated by the number they are proposed to contain, but it is an important point to know how many persons can be accomodated so that all may see and hear distinctly, and this is the especial respect in which many modern structures entirely fail. The defect has arisen from the foolish practice of copying Roman Catholic Churches, and the effort to rival their spacious magnificence.

"The Romanists," said Wren, "built large churches — it was enough if they heard the murmur of the mass and saw the elevation of the host — but ours are not to be fitted up for auditories. I can hardly think it practicable to make a single room so capacious as to hold above two thousand persons, and all to hear the service and see the preacher. A church should therefore be ninety feet long and sixty feet broad, besides a chancel at one end and a belfry, or portico, at the other." It would have been well if Wren had always practised the rules he laid down. The splendid inutility of St. Paul's is obvious to all: and it is surprising that such a man could have erected a Roman Catholic cathedral for a Protestant nation. We may mention that Exeter Hall, admirably adapted for sight and hearing, is 131 ft. 6 in. by 76 ft. 9 in. and 52 ft. 4 in. high: 2300 is the greatest number ever in it exclusive of those in the orchestra, making altogether 2800 persons. Wren mentions St. James's Westminster, as holding 2000 persons, "in the cheapest form" he could invent. "Concerning the placing of the pulpit," he remarks, "a moderate voice may be heard fifty feet distant before the preacher, thirty feet on each side, and twenty behind the pulpit; and not this, unless the pronunciation be distinct and equal, without losing the voice at the last word of the sentence, which is commonly emphatical, and, if obscured, spoils the whole sense. To build more room than that every person may conveniently hear and see, is to create noise and confusion." If there are galleries, the space between them should not be less than twenty-four feet, or at the least half the whole width of the room; the height under should not be less than ten feet.

With regard to the arrangement and the placing of the seats, the Commissioners for the erection of churches lay down the rule, that "in order to provide accomodation for kneeling during public service, the space in each pew and free seat must not be less than two feet eleven inches in the clear, when the height does not exceed three feet two inches from the floor of the pew, nor less than three feet if the height be greater; but the width of two feet six inches may be admitted if the back of the seats be not more than two feet eight inches high; twenty inches to be allowed for adults and fourteen inches for children." The pulpit and desk are recommended divided and to obscure the altar as little as possible; no square and double pews are permitted,

and all seats are to face the same way. Benches are to have backs inclining about three inches, and elbows are to be provided. The free sittings and pews should be intermixed as much as possible, in order that there may be little separation of rich and poor; and Wren says, — "A church should not be so filled with pews, but that the poor may have room enough to stand and sit." Fonts are generally placed at the west end of churches, and Robing Rooms are often provided with doors of access from without. Particulars of the construction generally will be found further on, but we may here remark that the Commissioners above mentioned require walls; —

	Ft.	In.
If of brick, not exceeding 20 feet in height and sustaining a roof of not more than twenty feet span	1 „	$10\frac{1}{2}$
If the height be more than twenty feet and the span of the roof to be sustained exceed 20 feet	2 „	3
If the height be more than 30 feet	2 „	$7\frac{1}{2}$

If the walls are of other materials, they are to be increased according to their quality.

We shall now proceed to a brief description of the design given.

Plate 30. contains plans of Ground and Gallery Floors of the Chapel. The extreme internal dimensions are 72 by 52 feet. There is a covered vestibule, the advantage of which is obvious. Doors on both sides lead to staircases conducting to the Galleries. Three central doors lead into the body of the Chapel, and within these are lobbies and additional doors, thus deadening the entrance of noise from without and preserving warmth. The entrances to the central and side aisles and galleries are kept distinct to prevent the crowding caused by the meeting of different streams of people. If preferred, doors may be placed leading from the side aisles into the staircase lobbies; but there will be the objection of the contact of the people from the galleries and side aisles, and the arrangement shown will be found most convenient. Two Robing Rooms, with fireplaces and W. Cs., or closet and W. C., are shown under the galleries. The pews are of different and convenient sizes, and the seats for children occupy the cross gallery in front of the organ. The pulpit and clerk's desk are connected together and placed centrally as most conducive to sight and hearing. The gallery is supported on iron columns, which, although they have always a tenuous, poor and often unsubstantial appearance, are advantageous in obscuring as little as possible the officiating minister. The font is placed at an angle of the chapel in an open space appropriated to it.

Plates 31, and 32, contain the Front and Side Elevations, and Transverse and Longitudinal Sections, showing the general construction and decorative effect. The Elevations are in Italian architecture with an admixture of Greek feeling; and it has been endeavoured to give to them the peculiar character now generally sought to be obtained in Chapels of this description.

The construction as shown in the Sections is extremely simple. The roof is to be of iron and wood, and the character of the cornice and ceiling and the degree of its enrichment will depend on the funds at command, and the taste and feeling of the proprietor.

Plates 33. to 37. contain the working details, but before describing them, we will make some remarks on the general construction.

Concrete is not shown to the foundations. If required, it may be 3 feet deep and twice the width of the lowest course of footings. It is to be composed of 6 gravel to 1 lime, tipped over from the barrow at the lowest possible level, and no other materials should be substituted.

The walls are to be built of the thicknesses and with footings in the manner shown. Good sound stock bricks to be used with what facing of brickwork shows of second malms, the joints raked out and tuckpointed. The arches are to be turned in half brick rings, and all requisite centring is to be provided and not to be struck until directed. Form fireplaces, flues, bricknogged partitions to W. C. and generally complete brickwork as shown.

The mortar to be composed of fresh burnt lime and clean pure sand in the proportion of 1 to 3,

well mixed together and chafed in a pug-mill. The drains to be 4 inch stoneware, with syphon traps, and all requisite bends, junctions, etc.

Tyerman's patent hoop iron bond, $1^3/_4$" wide, is to be used in tiers of two courses every 6 feet. It may be procured for 8 shillings per thousand feet above the current price of hoop iron and is a considerable improvement on the old bond. The external plastering is to be run, moulded and finished in the best Portland cement, 1 cement to 2 clean sharp sand; it is to be brought up to an uniform face, the arrises accurately cut, the moulds for the cornice to be approved previous to use, and the surface ultimately well fined off with fine white sand.

The internal plastering to be of good stucco worked to a fine sandy surface, the walls being previously rendered, set and floated to receive the stucco. Put Portland cement skirting (1 cement to 2 sand) where wood skirtings are not described and to pilasters, etc., at Communion space. The ceilings to be lathed, plastered, floated, set and whited.

The Mason is to work in self-faced York cores where requisite to the cornices, both edges coped parallel and the joints squared and set in cement.

York landings and granite bases are to be provided for the cast iron columns, with stub holes sunk for the bases as shown on Plate 35.

The steps at entrance to be rubbed York, in as long lengths as possible, breaking joints; and the paving to vestibules and aisles is to be 3 inch rubbed York, in parallel courses, bedded and jointed in mortar on ground well rammed, dry rubbish, or concrete.

The staircases to have Portland stone spandril steps, back-jointed, worked fair all round and rubbed, with moulded nosings continued round, and curtail bottom steps.

The landings to be 6 inches thick, with joggled joints set in cement, rubbed both sides, and, together with the steps, tailing into the wall 9 inches and securely pinned up; cut holes for iron balusters.

Provide chimney pieces, with slabs and hearths, and every requisite, to render the Mason's work complete and perfect.

The fir timber to be sound yellow Riga, Dantzic or Memel, free from every defect, and thoroughly seasoned. The oak to be English, and the deals to be hearty, sound, Christiana, free from sap, shakes, wainey edges, and loose knots.

The carpenter is to provide all scaffolding, centring, turning pieces, etc., and to erect a board and office for clerk of the works. The framing is to be put together in the manner shown; the principal timbers to bear as much as possible on the walls, the joists and rafters not to exceed 14 inches from centre to centre; the plates to be lapped at the angles, and to continue to 9 inches from the outer face of the walls; all lintels to be 6 inches deep; and the ceilings to be made perfectly level before lathing for plastering.

The roof is shown on Plate 33, and is to be framed and put together in the manner indicated with timbers of the following scantlings.

Tie Beam	15×9 inches.
Principals	12×9 „
Struts and Crosspieces	7×6 „
Small Queen Posts	9×6 „
Straining Piece	12×9 „
Purlins	$8 \times 4^1/_2$ „
Rafters	$5 \times 2^1/_2$ „
Joists to flat averaging	$9 \times 2^1/_2$ „
Ceiling Joists	$5 \times 2^1/_2$ „
Plates	5×5 „

Horizontal tie beams ought always to be used in roofs of wide span, whether open or not; and the intervals between the trusses should not exceed ten feet; unless intermediate trusses are

The W. Cs are to be fitted in the ordinary manner as described in former specifications. The windows are to have cast iron sashes made to open.

Open seats are now very general in churches, and if they have doors, these, together with the backs of the seats, are kept very low. On these divisions, a considerable amount of decoration in the panelling and carving is often lavished, and the pulpit and reading desks are sometimes very elaborate specimens of art. The *poppy heads*, or ornaments on the top of the upright ends or elbows which terminate seats, give rise to endless varieties of designs, *fleur de lis*, flowers, animals, figures, etc. These are common in Gothic architecture; but in some old churches in London very richly carved pews and pulpits of elaborate design are found. On plate 11, will be found some details of open seats; and as pews are preferred in chapels, we have devoted plate 36, to details of a plain example likely to be practically useful. For carved work generally, oak unpainted is undoubtedly preferable to fir. Yellow deal is proposed in the example now given. The panels should not exceed eleven inches in width; seven is desirable. Inch $^1/_2$ beaded enclosing partitions, one panel high (two are common), inch $^1/_2$ bolection moulded and bead flush doors, with bottom rails 6 inches wide, and stiles, top rails and munnions 4 inches wide, hung on 3 inch brass butts with projecting knuckles, and provided with brass knob pulpit latches. Details of panel and meeting stiles of doors are given half full size. Wainscot capping, as detail, half real size, moulded and grooved to tongue in partitioning. This capping is to cover all the enclosure, as well as the doors. The upright framing is to be secured to the floor and steadied by means of angle irons and screws, placed where most out of sight. The framing of the tread below is to be tenoned into the riser, but this and the flooring has been before described. Inch $^1/_4$ seats, rounded on the outer edge, 13 inches wide, curved towards door as shown. Inch $^1/_2$ cut brackets to support seats, from 2′ „ 6″ to 3′ „ 0″ apart, with chamfered bearers at ends against sides of pews. The flap seats are to have strong joints and are to be hung with butts or strap hinges. $^3/_4$ inch book boards, 6 inches wide, with $^1/_2$ inch rounded capping, tongued into groove in book board, and $^1/_2$ inch cut brackets about the same distance apart as those to the seats. The ends of book boards are to be rounded as indicated next to the pew doors to give space on entering. The children's seats and those round galleries are to be as shown on Plate 35, 11 inches wide, rounded on front edge, with no backs; the cut brackets to be of the distance apart above described, and all to be out of inch $^1/_4$ stuff. Free seats (if any are introduced) are not to be inclosed. They are to be out of inch $^1/_2$ deal, with sloping backs, framed with stop-chamfered stiles, munnions and rails, 4 inches wide, with similar standards, ends and chamfered bearers. The seats and brackets may be as described for the pews.

The organ is to be inclosed with framing and door similar to that described for the pews. For the organ itself we need give no description; it should of course correspond in the style of its decoration with that of the general design of the chapel.

The pulpit given on Plate 37, is to be of inch $^3/_4$, or two inch deal, framed and put together as shown, with bold beads at angles, and bolection moulded and bead flush framing, the inner beads being omitted in the lower inclosed part. The door is to correspond and be hung on similar butts to the pews, with brass pulpit latch. Put round top wainscot capping of the profile shown, ploughed to tongue on framing. The mouldings and skirting to be of deal as indicated. Strong rough framing within to support pulpit, and inch deal floors on joists 12 inches apart and of a scanthing of 4″ $\times$ $2^1/_4$″. Inch treads, grooved to similar rebated risers, moulded returned nosings, $1^1/_4$″ cut, sunk and beaded string board, the risers tailing through pulpit where next to it. Strong fir carriages and curtail end to bottom step. The staircase to be rounded as shown on the plan, and the underside is to be covered $^3/_4$″ matched and beaded boarding. Moulded handrail as to stairs to Galleries and newel of wainscot, with turned and mitred cap; square bar dovetailed balusters, two to each step, four to be of iron, with core, plate and screws. The seat within pulpit is to be of inch $^1/_2$ deal rounded, with proper bearers and cut bracket.

The book board is to be of inch $^1/_2$ deal with $^3/_4$" rounded capping, rebated into groove in board; it is to be supported by the cut brackets and bearer in the manner delineated. The Clerk's desk is to have similar framing to the pulpit, returned at both ends, with torus skirting, secured to floor with angle irons. This floor, together with the treads, risers, and joists, is to be similar to that described to the pews. The book board is to be as that specified for the pulpit. The seat is to have inch $^3/_4$ wrought, cut and stop-chamfered ends or elbows as design; the lower part is to be of $2^1/_2$" deal, chamfered, rebated into groove in boarding and ploughed for tongue of part above. The seat is to be of inch $^1/_2$ stuff, with rounded edge and supported on chamfered bearers, or grooved into elbows.

The Communion rail and the seats etc. will be as preferred; the rail may be of iron or wood; but we do not specify the fittings to this part, as they depend on the appropriation of the chapel.

The cast iron for the columns, etc., is to be of the best soft grey metal, mixed if needful with a small portion of hard metal to stiffen it. The columns are shown in detail on Plate 35, together with the plates, bolts and mode of fixing. They are to be provided by the Founder, together with the other ironwork shown on the Plate, and that to the roof on Plate 33. $3^1/_2$ inch cast iron down pipes are also to be provided to the roofs, and they should be always outside the walls. Wrought iron, or wainscot rails to the stone staircases and upright bars 3 feet high, or of an ornamental pattern as may be preferred.

The lead to the flats to be 7 lbs. to the foot super and 6 lbs. to the gutters, hips and ridges; 4" socket pipes from cesspools into heads of rain water pipes. The lead is to be laid loose, free to expand and contract. The W. C. apparatus is to be of the ordinary description.

The woodwork where seen is to have three coats of paint, and the pews, pulpit, gallery front, woodwork of communion space, wall lining, skirtings, where not inclosed, inside woodwork of windows, outer part of entrance doors and organ, are to be grained wainscot in addition and twice varnished in copal. The remaining woodwork usually painted, together with the ironwork and the ornamental cement work at back of communion space, are to be finished stone or some other common colour. If the pewing, etc., is of wainscot, it is to be sized and twice varnished. If of deal it may be stained with some of the common stains, which may be procured for about 6 shillings per gallon.

The windows are to be glazed with Hartley's rough plate glass, $^3/_8$ inch thick in squares of the sizes shown, and by using which the necessity for blinds will be obviated. The Commissioners for the erection of churches require two casements to be placed in each alternate window of churches, one to ventilate the space above the galleries and the other that below when, as is too often the case, the galleries cut the windows in two, producing an effect in the highest degree unsatisfactory. As will have been perceived in our article on Ventilation, the adoption of the system recommended by the Commissioners is fraught with the greatest evil in churches containing heated congregations. The cold air, rushing in, falls like a cascade on the heads of those below, and a temporary cold is the least evil to be anticipated from the sudden chill.

The roof may be covered with Countess slating, laid on $^3/_4$" battens $2^1/_2$" wide and nailed with copper nails, or zinc (cheaper), two to each slate, every third slate to overlap the first 2 inches.

We shall not here enter into the subject of warming and ventilating places of worship, as two articles are devoted to the consideration generally of those subjects. Whatever the system adopted, it should be determined before the edifice is commenced, as subsequent alterations involve increased expenditure, and no system can be carried out so satisfactorily after the completion of the works as during their progress. All requisite flues should be provided, and care must be taken not to build any combustible materials into or close to them. Iron pipes are exceedingly dangerous. The fact has never been clearly explained, but it is nevertheless true, that there is a chemical action between hot iron and timber, the tendency of which is to generate ignition at a less temperature than is ordinarily necessary. This is true of hot water pipes; and

the concealment of them often prevents the discovery in time of the impending danger. All pipes for heating should therefore be kept as distant as possible from timber, and a casing of woodwork is a species of incendiarism, if we may use the term. The spaces beneath boarded floors should be amply ventilated, and the water on the windows resulting from condensation, should be conducted by means of small channels outside the building. A church or chapel can hardly be very healthy when a number of bodies are decaying in the vaults beneath. "I could wish," remarked Sir Christopher Wren, "that all burials in churches were disallowed; it continually disturbs the pavement and is besides unwholesome. I could also desire to see the burial ground at a distance from the church: cemeteries might be formed in the outskirts of London, of two acres extent, having one walk all round, and two cross walks, planted with yew trees. These four divisions would serve four parishes. There beautiful monuments might be erected, but the dimensions should all be determined, else the rich, with their large marble tombs, would shoulder out the poor." This system is now being carried out; but while others obtain credit for it, few are aware of its having been so long ago suggested by one whose views were in this respect as much in advance of his time as his humanity contrasts strongly with the prejudices of those who think they can never rest quietly unless in the family vault, with the organ loudly pealing as the voices of the living rise up in a prayer above.

In erecting churches and chapels it should be borne in mind that wood linings are the best conductors of sound, and, of all materials, the most vibrative and conducive to melody. Cushions on the pulpit desk and the book boards of pews, and more especially drapery, absorb sound and tend to hinder its free passage: all curtains and hangings should therefore be abolished. A flat ceiling inpedes sound and a curved roof assists it. The lofty vaulted pointed roofs of many modern churches are also very objectionable in this respect; and the multiplicity of windows and perforations are a great defect. Opera boxes lined with wood are found practically excellent in assisting hearing. The hall of the French Chamber of deputies is stated to be one of the finest apartments in the world for the transmission of sound. The form was recommended, after much study and consideration, by a committee of architects. It is semicircular on plan, with a flat dome and plain walls.

We have now only to add that the chapel under description will accomodate 950 persons in the pews and free seats round galleries, including the space for children fronting the organ. Erected in accordance with the above general specification, the cost will average £ 3300, exclusive of the warming apparatus and gas fittings. This sum may of course be reduced by modifying or omitting the exterior decorations.

THE SUPPLY OF WATER.

The most natural supply of water is that in the shape of rain or dew. To these may be added tidal rivers, overflowing their banks, springs, or lines of natural drainage of water, the ocean and streams. Sources of artificial supply, as wells and indeed most of the above, although derived from natural sources, require generally some sort of preparation for use, as cleansing, filtering, etc.

The supply of water from rivers depends on the distance of the rivers and their levels above or below the surrounding land. For the irrigation of land they are not generally available unless nearly at its level, as mechanical power, involving much expense, is required to raise the water. When adopted for the supply of towns, channels or pipes are used to convey it to tanks

or reservoirs for the purpose of purification. If the towns are much above the level of the adjoining rivers, springs from higher lands, or the natural drainage of water from them, are adopted. A town close to a river is, however, best situated for a supply of water, as one on a lofty site is drained with more facility, there being no expense in raising refuse matters for manuring purposes, although it is difficult to procure sufficient surface water to flush the sewers without resource to an artificial supply. In Egypt, water from the Nile is collected in large reservoirs by means of leathern buckets, and a plug being removed from the bottom of the cistern the water is conveyed through rills and made to irrigate the land. In Bengal wells are dug, and the water is raised and carried through channels over the land. In China and Southern Africa the rivers and brooks are availed of and passages are formed with great labour to obtain that supply of water without which the ground would remain a sterile waste. "The irrigation by submersion is in Lombardy limited to rice fields. Elsewhere, as for instance in Tuscany, it is employed to improve the soil by the deposit of earthy matter from the water, whilst in France and Germany it is employed both for arable lands and meadows, leaving them under water till a scum appears which indicates that the crust of the soil begins to decay. The irrigation adopted in Lombardy for arable and pasture lands, as well as for meadows, is by filtration; for one could scarcely call submersion that very thin veil of moving water so skilfully spread over the land by the irrigators, who in this point are the best agriculturists in the world. The irrigation by regurgitation (more properly subterranean irrigation) is not in use in Lombardy; but in Switzerland, in the neighbourhood of Berne, and especially at Hofwyl, a considerable extent of land is irrigated in this manner with great success. The famous Fellenberg reclaimed the bogs of his Hofwyl estate by the application of subterraneous drains, so contrived that by stopping their mouths when the surface of the soil is too dry, he compels the water to swell back to the roots of the grass. This mode of irrigation is not only adopted to grassy lands after they have been drained, but to every other description of light soil, especially in hot climates. It was common in Persia long ago."

Aqueducts, so much employed by the Romans, are still occasionally used for the conveyance of water, and are in some instances found to be cheaper than pipes. The city of New York is supplied with water from the river Croton by an aqueduct thirty-eight miles in length. The chief arcade consists of fifteen arches, eight of which are 80 feet span, and seven fifty, the greatest height being 150 feet from the foundation. The work cost three millions stirling, and it is capable of discharging sixty million gallons of water in twenty-four hours. The distributing reservoir contains 21,000,000 gallons and the receiving reservoir 150,000,000. Cast iron pipes are found to be admirably adapted to convey water, and they are put together with socket ends. Water was formerly supplied in elm pipes, 6 or 7 inches diameter, with service pipes 3 inches. The iron mains are from 12 to 30 inches, the sub-mains 6 or 7 inches, and the service pipes 4 inches in diameter. A preparation of lime water in the interior tends to prevent corrosion. With reference to the expense of conveyance, one of the highest authorities, Mr. Hawkesley says that, "the cost of transmitting water to a distance of five miles, and to a height of 200 feet, including wear and tear of pumping machinery, fuel, labour, interest of capital invested in pipes, reservoirs, engines, etc., amounts to about $2^1/_2d$ per ton."

Rain water, from its softness, is exceedingly valuable. 32 inches, or according to Dalton, 31.3 is the mean depth falling annually in England. It is not however equally distributed. In Cumberland, at Keswick, the average depth in seven years was found to be 67 inches; at Plymouth 45 inches; and in the west part of Scotland 30 to 35 inches. All the water falling on the roofs of houses should be preserved, if not used for the purpose of clearing the drains. A roof containing 400 square feet, or 20 feet square, receives annually 4800 gallons. This is a large quantity, and, if in a large town, a filtering tank will render it extremely valuable for household use.

Springs are natural hydraulic operations dependant on principles connected with the laws of fluids. They are supplied by rain, snow and vapour, part of which is absorbed, and a circulation of water kept up. Land springs are those near the surface of the ground, deep well springs being much lower, but both have a similar origin, their depth being due to peculiarities of site. Intermittent springs depend on the height of water at their source, and they are consequently sometimes dry and sometimes overflowing. The diagram in the margin will render clear the general nature of springs. "Suppose *A*, *A*, a porous substance through which the water filtrates readily, *B*, *B*, a stratum of loam or clay impervious to water. The water which comes through *A*, *A*, will run along the surface of *B*, *B*, towards *S*, *S*, where it will spring up to the surface and form a lake or bog between *S*, and *S*. Suppose another gravelly or pervious stratum under the last, as *C*, *C*, *C*, bending as here represented, and filled with water running into it from a higher level; it is evident that this stratum will be saturated with water up to the dotted line *E*, *F*, *F*, which is the level of the point in the lower rock or impervious stratum *D*, *D*, where the water can run over it. If the stratum *B*, *B*, has any crevices in it below the dotted line, the water will rise through these to the surface and form springs rising from the bottom of the lake or bog; and if *B*, *B*, were bored through and a pipe inserted rising up to the dotted lines as *c*, *o*, the water would rise and stand at *o*. If there were no springs at *S*, *S*, the space below the dotted line might still be filled with water rising from the stratum *C*, *C*, *C*. But if the boring took place at *G*, the water would not rise, but, on the contrary, if there were any on the surface, it would be carried down to the porous stratum *E*, *C*, *C*, and run off. Thus, in one situation boring will give water and in another will take it off. Wherever water springs, there must be a pervious and an impervious stratum to cause it, and the water either runs over the impervious surface or rises through the crevices in it." (Art. Drainage. Penny Cyclo.)

We are thus brought to the consideration of wells, which are adopted when other means of obtaining water are impracticable. As above indicated, there are supply wells to give water and absorbing wells to carry it off, draining land and serving also as a source of supply to other wells. This latter consists simply in *tapping*, or communicating with a lower permeable stratum. Wells are also divided into two kinds, the common and Artesian. The common are often of large diameter cut through the surface strata down to the spring supplied by the filtrations of the surrounding land and termed a land spring. The surface of the ground is permeable, the substratum retentive, and the waters sinking till stopped are of course unable to rise and accumulate in a spring. Artesian wells are bored down to deeper seated springs. A porous stratum situated on a high level sinks gradually down under an impermeable stratum. The water falling on the porous stratum naturally sinks under the impermeable in the effort to find the lowest level, until it meets a retentive substratum. The impermeable stratum above prevents it rising, but if this be bored through, the water will rise with a force proportioned, considering friction, to the level of the high ground whence it was originally derived and has gradually flowed. The simple law of hydrostatic pressure accounts for this. Artesian wells were introduced into England from Italy and France about 1790, and one at Mortlake was bored through gravel, London clay and sand into chalk to the depth of 375 feet, the bore being $3^1/_2$ inches diameter. In the London Basin the rain falling upon the porous chalk at a distance on a high level accumulates at its lowest parts beneath the city, and, being retained by the impermeable London clay above and the blue clay below, if the upper clay is bored, the water rises to a level corresponding

with that of the chalk whence it was originally derived. Where there is hard chalk or rock, *steining*, as the lining of brickwork of wells is termed, is not essential except near the surface of the ground. In the stiff clay of the London basin half brick steining is adopted for small wells and whole brick for larger ones. Cement is used, mixed with an equal proportion of sand, but if mortar be adopted, it ought to have blue lias lime, or it will dissolve and render the water hard. Malm paviors are best adapted for steining, although stock bricks are used, but they ought to be very uniform in size and shape and very hard, as they necessarily only touch at the edge. Dry steining is chiefly used, with occasional rings executed in cement and at intervals, dependent on the character of the strata through which the well passes; in London clay these are from 5 to 12 feet. The diagram shows the mode of executing either $4^1/_2$″ or 9 inch steining; the open intervals behind where the bricks approach are better filled with cement than slate or other wedges. Puddling behind brickwork in going through loose loam or wet sand is now superseded by concrete. Cylinders of iron are sometimes used instead of cement work in passing land springs. When in the excavation the earth begins to be too weak to stand of itself, a curb of elm is inserted and the brick lining is commenced on it. The bricks, we may mention, should be well burnt so as not to part with the carbonate of lime contained in the earth. The following are the directions of Mr. Swindell for boring. "At the bottom of the well, when it has attained the depth of 200 feet, insert full 2 feet from the bottom a cast iron pipe, 12 inches diameter and 9 feet long; then bore with an $11^1/_2$ inch augur, shell, or other tool requisite, and fit into the hole, 8 inch wrought iron boring pipes of the usual construction; after attaining a depth of bore at which 8 inch pipes will no longer drive, insert 6 inch; make all joints in the said pipes secure and good, providing the solder and materials for the purpose.

The lower pipes to be well driven into the spring, and to have holes in the same to allow sufficient water-way; the upper pipe to stand 12 feet above the bottom of the shaft. Provide and fix all temporary wooden trunks before commencing boring, and do all temporary work required during the progress of the boring and other work."

The fouling of the air is very sensibly felt by well diggers as the depth increases. A bellows, or fan-blast, is used to propel air down zinc tubing. This causes much greater ease and expedition in the erection of the works.

Digging and steining dry in half brick work to wells 4 feet in diameter costs generally in London, including stock bricks, about 10 shillings per foot for the first ten feet, 12 shillings for the next 5 feet, and 15 shillings per five feet lower, exclusive of the cost of curbs and pumps if requisite.

With respect to the *quality* of water, we may observe that all water as *naturally* supplied is more or less impure. Rain water is least so, but it contains ammonia. Pure water is oxyde of hydrogen, consisting of 8 of oxygen to 1 of hydrogen. Water may be impure either by mechanical or chemical mixture. Distillation and other processes are requisite to remove chemical impurities, and filtration will remove those which are mechanically combined.

Many waters derive a decided character from the soils through which they percolate, although rendered purer by the distribution of impurities in the sand, etc., and the seizing of organic matter by the roots of vegetables. Peat colours water greatly; limestones imbues it with lime, and sandstones with carbonate of ammonia. River water is peculiarly adapted for filtration, which carries off the vegetable and animal matters, but the chemical ingredients in water, derived through springs and surface drainage from the earth, cannot be separated by filtration. Mineral waters are often valuable for their peculiar medicinal properties; such as carbonated

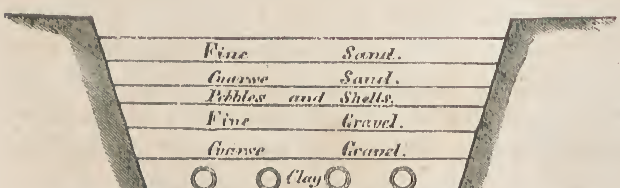
waters, containing carbonic acid, sulphurous waters, holding sulphuretted hydrogen, and chalybeate waters, with sulphate or carbonate of iron. Waters containing a chemical compound of lime are termed hard; and this in excess occasions an additional consumption of soap for cleansing purposes, causing great mechanical effort and consequent wear and tear of the materials operated upon. Rain water, from its softness and solvent powers, is as valuable in cookery as for washing. Spring water depends entirely on the strata it has passed through, chloride of sodium rendering it saline, salts of lime hard, carbonic acid sparkling and pleasant to the palate; but the best is the freest from any mixture. River water is a mixture of spring and rain water, mixed with vegetable matter and detritus. Well water from a greater depth than spring water is more affected by the soil, and in London this, or pump water, is hard and unadapted for washing and cooking; but the Artesian well water is found to be softer.

We shall not offer any observation on the chemical operations by means of which pure water is obtained, but content ourselves with a few remarks on the two chief modes of cleansing water, by settling, or subsidence, and filtering.

Connected with water works are reservoirs in which water is allowed to accumulate for some time, generally remaining undisturbed for twenty four hours at least, the water being then drawn from the upper part. Some solid matter still remains suspended, and to take away this filtering, consisting in passing the water through beds of permeable materials retaining impurities, is adopted.

Natural filtration through the soil thus renders spring water tolerably pure, although, as before mentioned, the character of the geological formations greatly affects it. Gravel, sand, shells and pebbles, together with charcoal, are the materials generally employed in filters, which should be self-acting and self-cleansing. Mr. Dempsey remarks, — "In the use of charcoal, as a filtering agent, an attempt is made to effect something more than the mere mechanical clearing of the water by absorbing some of the gases with which it is chemically adulterated. How far this expedient is valuable is, however, very questionable. The power of charcoal to act in this manner is well known to depend upon its being thoroughly and recently burnt and dry. Moisture diminishes this absorbing power, and in a short time the chemical action of the charcoal ceases.

Some difference doubtless in this respect exists between animal and vegetable charcoal, but neither of them can be admitted as an effectual chemical agent in the purification of water without requiring a costly rapidity of renewal quite impracticable upon an extended scale."



The wood cut in the margin shows a good form of public filter; brick channels or pipe tubing take off the water, and 6000 gallons may, on the average, be filtered at the cost of one penny. At page 174 of the first Series will be found an illustration of a convenient description of small filter.

With reference to the *quantity* of water that should be supplied to private houses, from 20 to 30 gallons per Diem for each inmate is a full allowance for all purposes. The Preston water works supply 80 gallons a day to each house; those at Ashton-under-Lyne 55 gallons; and at Nottingham 80 or 90, or about 18 gallons for each person; but these figures include the factories. At Nottingham the charges are from 5 to 60 shillings per annum according to the rental of the houses; in London they vary from $2^1/_2$ to 5 per cent upon it; and for manufacturing purposes from 2 to 6 shillings per thousand gallons. The cost of raising water, as stated by the Commissioners of Inquiry into the State of Large Towns is, for raising 1000 gallons 100 feet high $0^s\ 0^d .543$, and that for raising 22,099 gallons 1 shilling. We have before remarked on the

great superiority of the constant over the intermittent system of water supply (Page 235), and its advantages in case of fire are sufficiently obvious. Great quantities of water are required in cities for the purpose of watering the streets; one ton will lay the dust over 400 square yards of granite paving, or 600 yards of gravelled or macadamized roads.

London is supplied with water by several public companies. The Chelsea supplies Thames water filtered, and has also reservoirs in the Green and Hyde Parks; the West Middlesex supply water from Hammersmith, and the Grand Junction from Kew. The water of the Southwark, Vauxhall and Lambeth Companies is also derived from the Thames. The Hampstead make use of the springs on Hampstead Heath. The New River derive their supply from wells sunk in the chalk at Amwell and from Chadwell spring in Hertfordshire. The East London Water is derived from the river Lea.

MISCELLANEOUS DETAILS.

PLATES 38. to 45.

DETAILS OF SKYLIGHTS, PLATES 38. 39. 40. 41.

The first two plates 38. 39. contain details of a large skylight of an ordinary description to be placed on a flat. Plate 39, shows the parts in detail to so large a scale that very little description is necessary. Fir timber is proposed to be used, the sills only being of British oak; 2 inch ovolo sashes fixed with beads in the manner shown and strong copper bars secured with counter sunk screws: the dotted lines at the bottom of the sashes show the holes for condensation. The framework to be put together in the manner indicated, with inch boarding and rounded rolls to the flat and inch lining within the mouldings to be screwed on; wrought iron brackets to be provided to the ventilator, which is to be filled in with perforated zinc. 7 lb. milled lead is to be used and 21 oz. sheet glass.

Bracketting is to be provided for the cornice within, which is to be executed in plaster, about four fifths of fine stuff to one of plaster of Paris.

Plate 40, contains a *plan and section of a skylight* circular on plan, proposed to be framed and put together with fir timber and oak sill, with sashes on the outer face; the top light may be of iron or zinc; if of wrought iron to have rebated and moulded bars $1^1/_2'' \times 2''$, with wrought iron bottom curb $2'' \times {}^1/_2''$, and a moveable ventilator, with cord, balance, and weights complete; the skylight to be carefully framed and rivetted together and fixed upon the wood curb. The wood skylight below is extremely simple in construction, the frames are to be chamfered to give a finish to the caissons, and are to be rebated to take inch $^1/_2$ lights. 7 lb. milled lead is to be used, and sheet glass as before described.

Plate 41, contains a detail of a *lean to roof* 33 feet span, with *two descriptions of skylights,* the upper one being a two inch deal chamfered bar skylight, with a wide frame to protect the lower parts and properly blocked up above the roof, following the same rake; and the lower having solid fir frames, $4'' \times 4''$ with $1^1/_2''$ ovolo sashes, some of which may be hung on centres, with cut beads, stops, lines, pullies, and hooks complete; the sills to be of oak blocked up above roof and the frames to be rebated and chamfered. The lining within both skylights may be $^3/_4''$ matched and beaded boarding; or, as shown on the plan of lower skylight, sashes may be introduced at the ends. The roof is to have principals $10'' \times 6''$, rafters $5'' \times 2^1/_2''$, struts $6'' \times 3''$, and purlins $7'' \times 4''$. The trimming pieces and curbs to skylights are to be as shown; and the gutter is to be laid with inch yellow deal gutter boards, edges shot and laid with fair surface,

with all requisite drips, etc., on stout framed bearers as indicated, with tilting fillets; fall 2 inches in 10 feet; drips $1^3/_4''$ deep, ten feet apart; cesspools three inches deep; and 12 inches to be the narrowest width of gutter, and also the length of cesspools. The rafters over lower skylight to be as the others described; plates $4'' \times 4''$. The ironwork to be as shown; inch $^1/_2$ bolt, with head, shoes, socket, and all proper nuts, screws, plates, etc., complete; the screws to have a clean thread and the nuts to fit the bolts without any play, each nut being at least equal in size to twice the diameter of the bolt and one and a half times in thickness.

DETAILS OF RAILINGS, ETC. PLATES 42. 43.

Plates 42. 43. contain *details of cast iron railings, gates and posts;* the latter being either of stone or iron; details of the mouldings are given, and either design may be adopted as preferred. The curb is to be of stone chamfered on both sides. Plate 43, shows all the parts in detail to a scale rendering superfluous any further description after the specifications before given.

DETAIL OF PARTITION. PLATE 44.

Plate 44, contains a detail of a very strongly framed partition. The head and lower sill are to be $12'' \times 6''$, and the upper sill $9'' \times 6''$. The large braces and straining pieces are to be $6'' \times 6''$ and the smaller $6'' \times 4''$; the posts are to be $6'' \times 4''$, and the quarters $6'' \times 2^1/_2''$. Inch $^1/_2$ wrought iron bolts, with heads, shoes, sockets, etc., as indicated on the plate.

ARCHITRAVES. PLATE 45.

Plate 45, contains *details of architraves to doors and windows,* those to the left being suitable for doors and to the right for windows with folding shutters. In the centre are some example of panels and mouldings half real size.

THE MEASUREMENT AND VALUATION OF ARTIFICER'S WORK.

The object of this article is to present a brief but comprehensive view of the mode of measuring and valuing artificer's work, together with Tables facilitating these operations; and we shall preface the separate consideration of the different trades with a few remarks on the general mode of procedure.

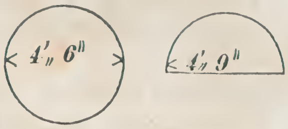
Work is either measured and valued after execution or, prior to this, from the drawings, elucidated by specifications, in order to form an estimate. In the former case five feet rods are used; in the latter reference is made to the scales on the drawings: our observations will apply to both, the proceedings being similar.

The dimensions are entered in a book if actual work is being measured, and on a sheet of paper if the dimensions are taken from drawings. The book, or paper, is ruled with appropriate divisions. One column to the left is for the number of times the dimensions in the next column to the right are to be taken; the third is left blank for the result of the multiplication of the figures; and the fourth contains the particulars of the work measured.

Indication should be given of the manner in which dimensions are obtained when, as is frequently the case, several are taken together, so that it will be easy to settle any misunderstanding that may subsequently arise. If dimensions are to be doubled or trebled, it will be often advisable to do this at the time of taking them, and generally, to leave as little as possible that can be easily done at once to a future period; all deductions should be entered as they occur.

A certain order, method and rotation, and the habit of taking certain works in regular, appropriate succession, are absolutely essential to secure the non-omission of any portion and to ensure an accurate result. It is difficult to lay down rules which apply invariably with the utmost appropriateness, and the practice of eminent surveyors considerably varies.

The work should be dissected as much as possible; the length is taken first, then the width, and lastly the depth or height; and each trade is taken and completed separately and one floor before another: it is usual to begin at the left hand of a building, working towards the right. The order of the trades may be thus; — Excavator, Bricklayer, Slater, Carpenter, Joiner and Ironmonger, Mason, Plumber, Plasterer, Smith and Founder, Glazier, Painter, Paperhanger, Gilder and Decorator. In entering the particulars certain abbreviations are in constant use and save much time. We have not space to give them, but the general principle consists in the indication of certain words by their initial letters. When dimensions are taken from drawings for the purpose of supplying Bills of Quantities to builders to give estimates and it is difficult accurately to describe an article, so as to allow of a price being affixed, a sketch is made of it.



In taking the dimensions of circular forms, they are entered as in the margin, with the diameters placed within them.

After the dimensions are taken they have to be *squared*, a knowledge of duodecimals being thus essential; on this subject we do not enter, the reader being presumed to possess at least such an amount of knowledge. We may however here mention that multiplying half the diameter by half the circumference will give the contents of a circle; $1\frac{1}{2}$ times the diameter and $\frac{1}{7}$th the half diameter being half the circumference: 3 times the diameter and $\frac{1}{7}$th the diameter is the total length of the circumference.

The quantities being prepared as above, they are all brought together by *abstracting* them in columns under their appropriate headings. The dimensions are first glanced over to see what articles are to be brought into the abstract, and the paper is ruled in an appropriate manner. A regular rotation is to be preserved facilitating rapid reference to any article; and this desirable end will be promoted by placing first the articles of least value and mounting upwards. Each trade of course requires a different form of abstract, and, when speaking of them, we shall indicate this; but we may remark that cubes are usually placed first, then superficial dimensions, afterwards running figures, and lastly the numbers of miscellaneous articles. Each division should start with the articles on which there is least labour, or which are of the lowest value.

The figures in the respective columns being cast up and reduced to the quantities at which it is customary to value them (such as concrete into yards, etc.), they are brought into the bill in the same rotation as in abstracting them, when all that remains is to fix the prices at which the value of the work is determined. Mr. Peter Nicholson attempted to found a system of valuation on a scientific basis by settling in decimals certain *constants* of labour, representing the days, or part of a day, requisite to perform a given quantity of work. Having thus the important item of time, it is only needful to multiply it by the rate of wages to obtain the value of the labour. The price fairly chargeable by the master in *Day Work* is to be taken, thus including his profit. The cost of materials has, of course, to be added. We merely mention the method in passing, for we have no great faith in it; and if adopted by a practical man he would be only smiled at for his pains. The system too is founded on the extraordinary assumption that certain modes of executing work are not to be varied; as if they are, in ever so slight a degree, modified by the advancing spirit of the age, the labour of calculating a set of decimal figures of time is nullified and quite thrown away.

Under the headings of the various trades the following order will be observed: first, the modes of measurement are stated; second, rules for valuation and the ascertainment of prices; third, memoranda of quantities, weights, etc., together with tables and general information.

EXCAVATOR.

MEASUREMENT. The method of taking the quantity of excavation is very simple; multiply the length by the width and depth, and reduce the product into cubic yards (dividing by 27), at

which it is priced. Levelling ground and reducing heaps is taken at the superficial yard, as is also the claying of vaults with tempered clay, the thickness being mentioned; forming slopes to embankments and cuttings is also priced at a super. dimension. If the depth of digging exceeds 6 feet this must be stated, as an extra price is consequent on it. Allow 6 inches beyond the footings on each side for space to work, and 9 inches if they are very deep and the ground is liable to fall in. If strutting is necessary, take the run of it, mention width and depth of trench, and describe "strutting and planking to perpendicular excavation." When ground falls and the areas of the two ends are not the same, if the sum of the two areas, with four times the middle area added, is multiplied by one sixth of the length, the product will be the cubic contents. Where there are piles, take the number and scantling of each, with the depth to which it is to be driven, and describe the shoeing, ringing and ironwork. To find the number of cubic feet of digging to wells for each foot downwards, multiply the square of the total diameter excavated by .7854, and for the number of gallons multiply also by .7854 and this product by 6.

If wells do not exceed 6 feet in depth, take the running measure and describe diameter, digging and steining. If above 6 feet, state it, take dimensions as cubic, and mention boring, gear, tackle, stages, etc., as specification. To find the number of cubic feet in a cesspool, multiply half the circumference by half the diameter, and this product being multiplied by the depth will give the number of cubic feet; dividing by 27 gives the cubic yards. In measuring for concrete only its exact size is to be allowed.

Abstract under heads of Digging and Wheeling, so many runs, in common soil, gravel, or stiff clay; Digging in Trenches and Ramming, and next the Concrete; the above being all cubes. Cubic dimensions for Wells, etc., are all to be brought under this heading. The supers. come next, as Levelling, etc., observing the order mentioned of placing the least expensive works first. The runs come last. The bills are to be made out in a similar order. We should mention that Excavator's is generally abstracted and billed with Bricklayer's work; the reduction into the usual pricing dimensions being made on the abstract.

VALUATION. One cubic yard per hour, or ten per diem, is the quantity of soft ground one man can excavate: if *hacking* is essential another man will be required to do the same work; or three to five yards cube per diem will be work enough for one: with strong gravel he will not make so much way. If the soil is sandy and wheeling is requisite, 30 cubic yards carried off 20 yards is fair work per diem for three men: for every 20 yards additional distance, allow one man. Three pence per yard for cutting (without profit), sixpence for cutting and hacking, and nine pence for two hackers, are fair prices. To value Concrete put the matter as follows;

6 yards of gravel or ballast per yard . .	£
1 Bushel of lime (ground, blue lias, etc.) .	
Carriage	
— Per Cent Profit	
Labour	
	£

MEMORANDA. One cubic yard of excavation, or 27 cubic feet, containing 21 striked bushels, equals a single load, and twice the quantity is termed a double load. 27 heaped bushels equal one load of gravel.

The carts for carrying away nightsoil contain $2\frac{1}{2}$ tons, or 45 cubic feet, in a space $6' \,„\, 0'' \times 3' \,„\, 3'' \times 2' \,„\, 4''$. 18 cubic feet equal 1 ton.

The weight of earth varies very considerably, from about 13 cubic feet of chalk to 24 of sand equalling 1 ton. The compression also is very various, and the cubic yard of course occupies a greater space after excavation. 27 cubic feet of concrete require 34 of sand, lime and gravel.

BRICKLAYER.

MEASUREMENT. In many districts in the country it is the practice to measure brickwork by the superficial yard, and thus regulate the price according as the thickness is 1, $1^1/_2$, 2, $2^1/_2$ bricks, etc. But the mode of procedure in the London district is to reduce all brickwork to what is termed the *standard thickness* of $1^1/_2$ brick, and price it by the *rod.* This is a solid mass $16^1/_2$ feet, or $5^1/_2$ yards, square, containing 272 feet 3 inches, one brick and a half, or $13^1/_2$ inches in thickness. The odd 3 inches, or quarter foot, are by general consent, not considered, and the cubic rod contains this 306 cubic feet ($16' \text{ „ } 6'' \times 16' \text{ „ } 6'' \times 13^1/_2''$). We may also find the number of rods in a wall by dividing the cubical content by 306, the quotient being rods and the remainder, if any, cubic feet. Another method is to multiply the solid contents by 8 (the number of $1^1/_2$ inches in a foot) and divide by 9 (the number of $1^1/_2$ inches in a brick and a half, or $13^1/_2$ inches in thickness): it is thus reduced to a thickness of $13^1/_2$ inches; and dividing this by 272 gives the number of rods. To reduce walls which are more or less in thickness than $1^1/_2$ brick to that standard, multiply the area of the wall by the number of half bricks it has in thickness, and divide the product by 3 (the number of half bricks in the standard thickness); this divided by 272 will give the number of rods.

Having premised thus much, we will now state the approved modes of measuring the various kinds of work, mentioning first generally, that no allowance is made in the quantities measured for difficult or small works, neither is the space occupied by timbers built in walls, nor are the apertures of flues, deducted, but where no brickwork is over bedding plates two inches are to be allowed for them.

Begin at the lowest point at the excavations and measure the footings. Take the height and length of the courses, multiply them and the product by the *mean* number of half bricks in thickness; dividing this by 3 will give the number of feet $1^1/_2$ brick in thickness. To ascertain the correct number of half bricks in the mean thickness, add together the number of half bricks in each course and divide by the number of courses. Another method is to take one half the total of the half bricks in the lower and upper courses; if there is an odd number of courses, take the number of half bricks in the central course.

All that is requisite in taking the walls is to get the superficial dimensions, length, height and respective thicknesses, entering these, leaving the reductions to the standard thickness till the work is abstracted, when it will also be reduced into rods; but, as before remarked, if we have the solid contents of a wall, dividing it by 306 will give the number of rods. Or, as at first mentioned, it may be priced at per foot super at its thickness, without reduction into rods. Of course care must be taken not to measure returning walls twice over, but to diminish *exactly* their length. All openings for doors, windows, etc., are to be deducted from walls with the exceptions previously mentioned. If a house is rectangular two walls may be measured externally on the face and the other two within, thus obtaining the two superficies. Bricknogging is measured solid, without deduction of the timbers in it, and it is valued at the superficial yard; all sills, timbers, stone strings, etc., built in walls are also measured in, but apertures and recesses are deducted. Walls built in cement must be kept distinct from those in mortar, in order to allow the difference of price. Angle chimneys may be measured solid and reduced to the standard thickness in the manners directed; ovens, coppers, etc., are taken similarly; the fire-place to rooms and ash hole to ovens are deducted. (The fire-bricks, tiles and Welsh lemps must not be forgotten.) Chimney shafts are also taken solid above the roof, as the flues are below. The former are sometimes girt round and this is multiplied by the height and 9 inch brickwork (twice, $4^1/_2''$ the thickness of the divisions of flues).

Facings of superior bricks are taken by the foot super. and charged as an extra; if the reveals to the windows and doors are not cemented they are to be measured in. Facing is usually

considered as two-thirds of a brick thick, and the backing brickwork may thus be deducted to this extent. Pointing is measured superficially.

Arches are measured on the face and soffite. Take the clear width of the door or window between the reveals, adding the projection of one skewback, and multiply the sum by the height of the arch. For the cutting take the length of the skewbacks by the thickness of the arch, or one is usually taken, multiplying it by two. To ascertain the amount of cutting to a semicircular arch, multiply half the circumference of the circle by 9 inches. Gauged arches are either deducted and charged, or, if not deducted, an extra price is allowed. Rubbed and gauged arches are always priced separately.

All cuttings, such as those to gables, outside splays, cut and rubbed fair, and inside cuttings rough for battens, etc., are measured and charged by the foot super, but bird's mouth is taken at per foot run.

Paving is taken at the foot super; irregular paving is run and described as "cutting and waste." Groins are measured as common work, with a run of cut groin; beads and cornices, tile creasing, lime and hair and cement filleting, by the foot run; and bedding and pointing sashes and door frames entered at so much each.

Drains are charged at per foot run, and those of large size in brickwork and sewers are measured up as ordinary brickwork; rendering them inside with cement is taken at per foot super. The moulds and centring are extra. The bends, junctions, traps, etc., to the stoneware drains are charged separately. Wells and cesspools are mentioned under "Excavator."

Plain and Pan Tiling are measured by the square of 100 feet. In Pantiling take the length of the hip-rafter by 12 inches for "cutting and waste," allow for the barge per foot run, collect hips and ridges into "hips and ridges," run filleting, number hip hooks and T nails painted three times in oil, deduct chimneys, and measure for dormers. Taking the length of the eaves by the whole girt over, from eave to eave, will include the hips, if any.

In Plaintiling it is customary to allow 4 inches for eaves, and 6 inches for dripping eaves, 12 inches for valleys, and 3 inches extra to cuttings, hips, etc.

In abstracting Bricklayer's Work the following rotation will be found convenient. Cube Brickwork, Superficial Brickwork, (so many bricks thick, under their respective headings, and deductions next to these); Brickwork circular on plan (headings and deductions as before); Brickwork in Cement; Bricknogging; Toothing Brickwork to Rubble Walling (if any) and also Backing to Ashlar; Facings, Arches, Cutting, Pointing, etc.; then the Running Dimensions, and lastly the Numbers. Keep separate the Paving, Tiling, and Drainage, also the Wells, Cesspools, etc. The dimensions are then to be added up, the deductions made, and the final totals reduced to the quantities at which they are to be priced; brickwork to rods, paving to yards, tiling to squares, and so on as before mentioned. In billing out the work the rotation of the simplest being placed first, as previously explained, is to be preserved, First insert the reduced brickwork, then supers, runs and numbers.

VALUATION. A reference to a Price Book will be found of the greatest assistance to the inexperienced in suggesting the most convenient mode of abstracting and billing out work, independently of the information to be obtained of its value.

The cost of making bricks in the neighbourhood of London is thus stated by Gwilt.

	£	s	d
Digging, wheeling, carting, etc.	0 „	1 „	6
Moulding, stacking, etc.	0 „	11 „	6
Sand, one sixth of two shillings . . .	0 „	0 „	4
Straw for hacks	0 „	0 „	9
Barrows, moulds, planks, etc.	0 „	0 „	6
Fuel, 9 cwt	0 „	10 „	6
For 1000 bricks	1 „	5 „	1

The quantity of clay required for 1000 bricks is about 54 cubic feet, allowing 5 feet for shrinkage.

To ascertain the cost of brickwork per rod, allowing a profit of 15 per cent, a simple rule is to multiply the prime cost of the bricks, including cartage, by 5, and add to this product the price of labour and mortar.

The valuation of a rod of brickwork may be estimated as follows; —

4533 stocks, at per thousand P. C. . . . .
1 Cubic Yard of stone lime, at per yard . . . . . .
$3^1/_2$ single loads, or yards, of sand at per load . . . .
$^3/_4$ Day labourer to slack, etc., mortar . . . . . .
Five days bricklayer and labourer at per diem . . . . .
1 Per cent for Scaffolding . . . .
15 „ „ Profit on prime cost . . . .

If cement is used, take 36 bushels of cement and also 36 of pure sharp screened sand: $1^1/_2$ cubic yards of *chalk* lime may be taken to 3 single loads of drift.

The valuation of a square of Pantiles laid to a 10 inch gauge may be put thus;

180 Pantiles, at per thousand P. C. . . . .
1 Bundle of laths . . . .
$1^1/_4$ Cwt 6*d* nails . . . .
Labour . . . .
Profit . . . .

We do not affix the prices on account of their continual variation.

MEMORANDA. With the assistance of a labourer, a bricklayer will lay 1500 place or 1000 stock bricks (about two cubic yards) in a day, or 500 malms in fronts, an advancing degree of care and nicety being requisite.

The two men as above will complete a rod of brickwork in four days and a half; but if there should be many apertures, or the work presents any difficulty in execution, a longer time should be allowed. 4352 stock bricks are required to the rod if the four courses are 1 foot high, and 4533 if they measure $11^1/_2$ inches. Generally speaking 4500 bricks are, allowing for waste, set down to the rod, which will weigh from 13 to 15 tons, containing $11^1/_3$ cubic yards, or 306 cubic feet. 4900 stocks are allowed for the rod in circular cesspools and wells.

The following tables will be found useful, assuming the number of bricks to the rod as given.

Aliquot Parts of a Rod of Place Bricks.

1 Rod	4500 Bricks.
$^3/_4$ „	3375 „
$^1/_2$ „	2250 „
$^1/_4$ „	1125 „
$^1/_8$ „	$562^1/_2$ „
$^1/_{16}$ „	$281^1/_4$ „
$^1/_{32}$ „	$140^5/_8$ „

Aliquot Parts of a Rod of Grey Stocks.

1 Rod	4900 Bricks.
$^3/_4$ „	3675 „
$^1/_2$ „	2450 „
$^1/_4$ „	1225 „
$^1/_8$ „	$612^1/_2$ „
$^1/_{16}$ „	$306^1/_4$ „
$^1/_{32}$ „	$153^1/_8$ „

16 Bricks go to a foot super. of reduced brickwork, marle facing require 8, and gauged arches 10. For bricknogging 30 bricks are requisite per yard super. if on edge, or 45 if laid flat. A stock brick is $8^3/_4 \times 4^1/_4 \times 2^1/_2$ inches, and weighs 5 lbs. A hod holds 20 bricks.

For the mortar to a rod of brickwork $1\frac{1}{2}$ cwt. or cubic yard of chalk lime to 3 single yards or loads of sand or drift; or if stone lime is used, 1 cubic yard will be requisite to $3\frac{1}{2}$ single loads of sand. For cement 36 bushels of it must be mixed with the same quantity of sand. 1 Load of sand and 9 bushels of lime are required for a cubic yard of mortar, and they lose one-third of their bulk when made up, as do also sand and cement: one third of their bulk of water is requisite, or $5\frac{1}{2}$ barrels to the rod. 2 Hods of mortar equal about a bushel, and 184 hods are required to the rod of brickwork; for 100 bricks 4 hods are necessary.

Putting the matter in another form 18 bushels of stone lime, or 27 of chalk, are required to the rod, to be mixed with the proportions of sand before mentioned. A single load of sand is $3' \,„\, 0'' \times 3' \,„\, 0'' \times 3' \,„\, 0''$; a double $3' \,„\, 0'' \times 3' \,„\, 0'' \times 6' \,„\, 0''$; a measure of lime $3' \,„\, 0'' \times 3' \,„\, 0'' \times 3' \,„\, 0''$; and a hod $1' \,„\, 4'' \times 9'' \times 9''$. 1 square yard of 14 inch walling requires $1\frac{3}{4}$ bushels of cement; and $\frac{1}{8}$ of a bushel will suffice for a square of pointing. $17\frac{1}{2}$ cubic feet of clay, 18 of common earth, and $23\frac{1}{2}$ of sand, each equal 1 ton.

The number of bricks required to the yard in paving is as follows; —

Paving bricks, laid flat .	36.	Size of each $9'' \times 4\frac{1}{2}'' \times 1\frac{3}{4}''$	Weight 4 lbs.
Do. on edge .	82.	„	
Stock bricks, laid flat .	36.	„ $8\frac{3}{4}'' \times 4\frac{1}{4}'' \times 2\frac{1}{2}''$	„ 5 lbs.
Do. on edge .	52.	„	
Dutch clinkers . . .	144.	„ $6\frac{1}{4}'' \times 3'' \times 1\frac{1}{2}''$	„ $1\frac{1}{2}$ lbs.
10 Inch Paving Tiles .	13.	„ $9\frac{3}{4}'' \times 9\frac{3}{4}'' \times 1''$	„ 8 lbs. 9 oz.
12 „ „ „ .	9.	„ $11\frac{3}{4}'' \times 11\frac{3}{4}'' \times 1\frac{1}{2}''$	„ 13 lbs.

In Plaintiling there are required to the square 600 to an 8 inch gauge (each tile showing 4 inches on the face), 700 to an 7 inch gauge (showing $3\frac{1}{2}$ inches), and 800 to a 6 inch gauge (showing 3 inches). The tiles are $10\frac{1}{2}'' \times 6\frac{1}{4}'' \times \frac{5}{8}''$, each weighing 2 lbs. 5 oz., a square of 700 weighing about $14\frac{1}{2}$ cwt.

For the square it is requisite to have 1 bundle of laths, 2 bushels of lime, 1 of sand (or 3 hods of mortar) and a peck of tile pins. 100 plain tile laths 5 feet long, 125 — 4 feet do., or 167 — 3 feet do., go to the bundle. For a bundle of 5 feet laths 500 nails suffice. Thirty bundles of laths to the load.

A square of Pantiling will require 150 to a 12 inch gauge, 164 to a 11 inch gauge, and 180 to a 10 inch gauge; $1\frac{1}{4}$ hundred of 6*d* nails and 1 bundle of laths are necessary. One pantile weighs 5 lbs. 4 oz., and a square about $7\frac{1}{2}$ cwt. A bundle of laths contains twelve 10 feet long by $1\frac{1}{2}$ and 1 inch.

We have now only to mention that in *day work* bricks are charged by the thousand, but kiln and fire burnt bricks and red rubbers are often charged by the hundred. Tiles are charged by the thousand; the laths by the load or bundle, and hip-hooks and T nails by the piece. Mortar is charged by the load and hod, and cement by the barrel or bushel. A bushel striked is, in proportion to a bushel heaped, as 4 to 5. Lime and hair is valued per load, and also sand, as well as by the yard cube. Lime and hair, pargetting and fine stuff, are also priced per hod. 5*s* 9*d* is the *day price* for a bricklayer, and 3*s* 9*d* for a labourer. It is not pretended that the system is unvaried, the fact being that scarcely two builders' accounts are entirely identical in system: all that we profess to do in this article is to indicate the general mode of procedure in the measurement and valuation of artificers' work. To give every particular and variation would far exceed the space at our disposal.

The following table indicates the number of bricks necessary for a given superfical amount o walling, of thicknesses varying from half a brick to $2^1/_2$ bricks.

Number of feet in area.	THICKNESSES.				
	$^1/_2$ Brick.	1 Brick.	$1^1/_2$ Brick.	2 Bricks.	$2^1/_2$ Bricks.
1	5	11	16	22	27
2	11	22	33	44	55
3	16	33	49	66	82
4	22	44	66	88	110
5	27	55	82	110	137
6	33	66	99	132	165
7	38	77	115	154	193
8	44	88	132	176	220
9	49	99	148	198	248
10	55	110	165	220	275
20	110	220	330	441	551
25	137	275	412	551	688
30	165	330	496	661	827
40	221	441	661	882	1102
50	275	551	827	1102	1378
60	330	661	992	1323	1654
70	386	772	1158	1544	1930
80	440	882	1323	1764	2205
90	496	992	1488	1985	2481
100	551	1102	1654	2205	2757
150	826	1653	2481	3307	3135
200	1102	2205	3308	4411	5514
300	1654	3308	4963	6617	8272
400	2205	4411	6617	8323	11029
500	2757	5514	8272	11029	13786
600	3308	6617	9926	13235	16544
700	3860	7720	11580	15441	19301
800	4411	8823	13235	17647	22058
900	4963	9926	14889	19852	24816
1000	5514	11029	16544	22058	25753
2000	11029	22058	33088	44117	55147
3000	16544	33088	49632	66176	82720
4000	22058	44117	66176	88235	110294
5000	27573	55147	82720	110294	137867
6000	33088	66176	99264	132352	165441
7000	38602	77205	115803	154411	193014
8000	44117	88235	132352	176470	220588
9000	49632	99264	148896	198529	248161
10000	55147	110294	165441	220588	275735
50000	275735	551470	827205	1102940	1378675
90000	496323	992646	1468969	1985292	2481615

In the table below the area of a wall in superficial feet is shown in relation to the number of reduced feet in thicknesses from $^1/_2$ a brick to $2^1/_2$ bricks.

Area.	REDUCED QUANTITIES.				
	$^1/_2$ Brick.	1 Brick.	$1^1/_2$ Brick.	2 Bricks.	$2^1/_2$ Bricks.
	Rods. qrs. ft. ins.	Rods. qrs. ft. ins.	Rods. qrs. ft. ins.	Rods. qrs. ft. ins.	Rods. qrs. ft. ins.
1	4	8	1 „ 0	1 „ 4	1 „ 8
2	8	1 „ 4	2 „ 0	2 „ 8	3 „ 4
3	1 „ 0	2 „ 0	3 „ 0	4 „ 0	5 „ 0
4	1 „ 4	2 „ 8	4 „ 0	5 „ 4	6 „ 8
5	1 „ 8	3 „ 4	5 „ 0	6 „ 8	8 „ 4
6	2 „ 0	4 „ 0	6 „ 0	8 „ 0	10 „ 0
7	2 „ 4	4 „ 8	7 „ 0	9 „ 4	11 „ 8
8	2 „ 8	5 „ 4	8 „ 0	10 „ 8	13 „ 4
9	3 „ 0	6 „ 0	9 „ 0	12 „ 0	15 „ 0
10	3 „ 4	6 „ 8	10 „ 0	13 „ 4	16 „ 8
15	5 „ 0	10 „ 0	15 „ 0	20 „ 0	25 „ 0
20	6 „ 8	13 „ 4	20 „ 0	26 „ 8	33 „ 4
25	8 „ 4	16 „ 8	25 „ 0	33 „ 4	41 „ 8
30	10 „ 0	20 „ 0	30 „ 0	40 „ 0	50 „ 0
35	11 „ 8	23 „ 4	35 „ 0	46 „ 8	58 „ 4
40	13 „ 4	26 „ 8	40 „ 0	53 „ 4	66 „ 8
45	15 „ 0	30 „ 0	45 „ 0	60 „ 0	1 „ 7 „ 0
50	16 „ 8	33 „ 4	50 „ 0	66 „ 8	1 „ 15 „ 4
60	20 „ 0	40 „ 0	60 „ 0	1 „ 12 „ 0	1 „ 32 „ 0
70	23 „ 4	46 „ 9	1 „ 2 „ 0	1 „ 25 „ 4	1 „ 48 „ 8
80	26 „ 8	53 „ 4	1 „ 12 „ 0	1 „ 38 „ 8	1 „ 65 „ 4
90	30 „ 0	60 „ 0	1 „ 22 „ 0	1 „ 52 „ 0	2 „ 14 „ 0
100	33 „ 4	66 „ 8	1 „ 32 „ 0	1 „ 65 „ 4	2 „ 30 „ 8
200	66 „ 8	1 „ 65 „ 4	2 „ 64 „ 0	3 „ 62 „ 8	1 „ 0 „ 61 „ 6
300	1 „ 32 „ 0	2 „ 64 „ 0	1 „ 0 „ 28 „ 0	1 „ 1 „ 60 „ 0	1 „ 3 „ 24 „ 0
400	1 „ 65 „ 4	3 „ 62 „ 8	1 „ 1 „ 60 „ 0	1 „ 3 „ 57 „ 4	2 „ 1 „ 54 „ 8
500	2 „ 30 „ 8	1 „ 0 „ 61 „ 4	1 „ 3 „ 24 „ 0	2 „ 1 „ 54 „ 8	3 „ 0 „ 17 „ 4
1000	1 „ 0 „ 61 „ 4	2 „ 1 „ 54 „ 8	3 „ 2 „ 48 „ 0	4 „ 3 „ 41 „ 4	6 „ 0 „ 34 „ 8
5000	6 „ 0 „ 34 „ 8	12 „ 1 „ 1 „ 4	18 „ 1 „ 36 „ 0	24 „ 2 „ 2 „ 8	30 „ 2 „ 37 „ 4
10000	12 „ 1 „ 1 „ 4	24 „ 2 „ 2 „ 8	36 „ 3 „ 4 „ 0	49 „ 0 „ 5 „ 4	61 „ 1 „ 6 „ 8

The number of plain or pantiles necessary to cover areas varying from 1 to 10,000 feet, according to the different gauges is shown below.

Feet super.	PLAINTILES. *Gauges.*			PANTILES. *Gauges.*		
	6 Inches.	$6\frac{1}{2}$ Inches.	7 Inches.	11 Inches.	12 Inches.	13 Inches.
1	$7\frac{1}{2}$	7	$6\frac{1}{2}$	$1\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{3}$
2	15	14	13	$3\frac{1}{3}$	3	$2\frac{2}{3}$
3	$22\frac{1}{2}$	21	$19\frac{1}{2}$	5	$4\frac{1}{2}$	4
4	30	28	26	$6\frac{2}{3}$	6	$5\frac{1}{3}$
5	$37\frac{1}{2}$	35	$32\frac{1}{2}$	$8\frac{1}{3}$	$7\frac{1}{2}$	$6\frac{2}{3}$
6	45	42	39	10	9	8
7	$52\frac{1}{2}$	49	$45\frac{1}{2}$	$11\frac{2}{3}$	$10\frac{1}{2}$	$9\frac{1}{3}$
8	60	56	53	$13\frac{1}{3}$	12	$10\frac{2}{3}$
9	$67\frac{1}{2}$	64	$58\frac{1}{2}$	15	$13\frac{1}{2}$	12
10	75	70	65	$16\frac{2}{3}$	15	$13\frac{1}{3}$
20	150	140	130	$33\frac{1}{3}$	30	$26\frac{2}{3}$
30	225	210	195	50	45	40
40	300	280	260	$66\frac{2}{3}$	60	$53\frac{1}{3}$
50	375	350	325	$83\frac{1}{3}$	75	$66\frac{2}{3}$
60	450	420	390	100	90	80
70	525	490	455	$116\frac{2}{3}$	105	93
80	600	560	520	$133\frac{1}{3}$	120	$106\frac{2}{3}$
90	675	630	585	150	135	120
100	750	700	650	$166\frac{2}{3}$	150	$133\frac{1}{3}$
200	1500	1400	1300	$333\frac{1}{3}$	300	$266\frac{2}{3}$
300	2250	2100	1950	500	450	400
400	3000	2800	2600	$666\frac{2}{3}$	600	$533\frac{1}{3}$
500	3750	3500	3250	833	750	$666\frac{2}{3}$
600	4500	4200	3900	1000	900	800
700	5250	4900	4550	$1166\frac{2}{3}$	1050	$933\frac{1}{3}$
800	6000	5600	5200	$1333\frac{1}{3}$	1200	$1066\frac{2}{3}$
900	6750	6300	5850	1500	1350	1200
1000	7500	7000	6500	$1666\frac{2}{3}$	1500	$1333\frac{1}{3}$
2000	15000	14000	13000	$3333\frac{1}{3}$	3000	$2666\frac{2}{3}$
3000	22500	21000	19500	5000	4500	4000
4000	30000	28000	26000	$6666\frac{2}{3}$	6000	$5333\frac{1}{3}$
5000	37500	35000	32500	$8333\frac{1}{3}$	7500	$6666\frac{2}{3}$
6000	45000	42000	39000	10000	9000	8000
7000	52500	49000	45500	$11666\frac{2}{3}$	10500	$9333\frac{1}{3}$
8000	60000	56000	52000	$13333\frac{1}{3}$	12000	$10666\frac{1}{3}$
9000	67500	63000	58500	15000	13500	12000
10000	75000	70000	65000	$16666\frac{2}{3}$	15000	$13333\frac{1}{3}$

The following table indicates the value of a rod of reduced brickwork, bricks being taken at prices ranging from 30 to 60 shillings per thousand, allowing for scaffolding, labour and mortar from 65 to 90 shillings per rod, and 4500 bricks to it.

Bricks per 1000.	LABOUR AND MORTAR.					
	£ 3 „ 5 per Rod.	£ 3 „ 10 per Rod.	£ 3 „ 15 per Rod.	£ 4 „ 0 per Rod.	£ 4 „ 5 per Rod.	£ 4 „ 10 per Rod.
£ s d	£ s d	£ s d	£ s d	£ s d	£ s d	£ s d
1 „ 10 „ 0	10 „ 0 „ 0	10 „ 5 „ 0	10 „ 10 „ 0	10 „ 15 „ 0	11 „ 0 „ 0	11 „ 5 „ 0
1 „ 12 „ 0	10 „ 9 „ 0	10 „ 14 „ 0	10 „ 19 „ 0	11 „ 4 „ 0	11 „ 9 „ 0	11 „ 14 „ 0
1 „ 14 „ 0	10 „ 18 „ 0	11 „ 3 „ 0	11 „ 8 „ 0	11 „ 13 „ 0	11 „ 18 „ 0	12 „ 3 „ 0
1 „ 16 „ 0	11 „ 7 „ 0	11 „ 12 „ 0	11 „ 17 „ 0	12 „ 2 „ 0	12 „ 7 „ 0	12 „ 12 „ 0
1 „ 18 „ 0	11 „ 16 „ 0	12 „ 1 „ 0	12 „ 6 „ 0	12 „ 11 „ 0	12 „ 16 „ 0	13 „ 1 „ 0
2 „ 0 „ 0	12 „ 5 „ 0	12 „ 10 „ 0	12 „ 15 „ 0	13 „ 0 „ 0	13 „ 5 „ 0	13 „ 10 „ 0
2 „ 2 „ 0	12 „ 14 „ 0	12 „ 19 „ 0	13 „ 4 „ 0	13 „ 9 „ 0	13 „ 14 „ 0	13 „ 19 „ 0
2 „ 4 „ 0	13 „ 3 „ 0	13 „ 8 „ 0	13 „ 13 „ 0	13 „ 18 „ 0	14 „ 3 „ 0	14 „ 8 „ 0
2 „ 6 „ 0	13 „ 12 „ 0	13 „ 17 „ 0	14 „ 2 „ 0	14 „ 7 „ 0	14 „ 12 „ 0	14 „ 17 „ 0
2 „ 8 „ 0	14 „ 1 „ 0	14 „ 6 „ 0	14 „ 11 „ 0	14 „ 16 „ 0	15 „ 1 „ 0	15 „ 6 „ 0
2 „ 10 „ 0	14 „ 10 „ 0	14 „ 15 „ 0	15 „ 0 „ 0	15 „ 5 „ 0	15 „ 10 „ 0	15 „ 15 „ 0
2 „ 12 „ 0	14 „ 19 „ 0	15 „ 4 „ 0	15 „ 9 „ 0	15 „ 14 „ 0	15 „ 19 „ 0	16 „ 4 „ 0
2 „ 14 „ 0	15 „ 8 „ 0	15 „ 13 „ 0	15 „ 18 „ 0	16 „ 3 „ 0	16 „ 8 „ 0	16 „ 13 „ 0
2 „ 16 „ 0	15 „ 17 „ 0	16 „ 2 „ 0	16 „ 7 „ 0	16 „ 12 „ 0	16 „ 17 „ 0	17 „ 2 „ 0
2 „ 18 „ 0	16 „ 6 „ 0	16 „ 11 „ 0	16 „ 16 „ 0	17 „ 1 „ 0	17 „ 6 „ 0	17 „ 11 „ 0
3 „ 0 „ 0	16 „ 15 „ 0	17 „ 0 „ 0	17 „ 5 „ 0	17 „ 10 „ 0	17 „ 15 „ 0	18 „ 0 „ 0

TABLE OF COST OF BRICKWORK.

Bricks per M.	Labour.	Cost per Rod.
10 shillings	£ 2 „ 8 „ 0	£ 4 „ 13 „ 0
11 „	„	4 „ 17 „ 6
12 „	„	5 „ 2 „ 0
13 „	„	5 „ 6 „ 6
14 „	„	5 „ 11 „ 0
15 „	„	5 „ 15 „ 6
16 „	„	6 „ 0 „ 0
17 „	„	6 „ 4 „ 6
18 „	„	6 „ 9 „ 0
19 „	„	6 „ 13 „ 6
20 „	„	6 „ 18 „ 0
21 „	„	7 „ 2 „ 6
22 „	„	7 „ 7 „ 0
23 „	„	7 „ 11 „ 6
24 „	„	7 „ 16 „ 0
25 „	„	8 „ 0 „ 6
26 „	„	8 „ 5 „ 0
27 „	„	8 „ 9 „ 6
28 „	„	8 „ 14 „ 0
29 „	„	8 „ 18 „ 6
30 „	„	9 „ 3 „ 0.

SLATER.

MEASUREMENT. The measurement and valuation of Slater's work is extremely simple. It is taken superficially and valued by the square of 100 feet. When the eaves are double, allow six inches extra for them, and 9 inches if imperials or rags are used. Take the length of hips and valleys by 12 inches, and all cutting to chimneys, etc., by 6 inches for cutting and waste. Run cement filleting. Slate ridges and hips are also taken at per foot run. Slate slabs are priced according to thickness and as they are self faced, planed one or both sides, rubbed, and have filed and rubbed edges, rounded nosings, grooves, etc., which latter are run. Sanding and snaking, or polishing, are of course extra. Cisterns and sinks may be taken at per foot super. or priced according to description. Steps and sills are usually taken at per foot run. Mangers are priced according to size and workmanship, as well as a great variety of other articles, including chimney pieces, etc., now manufactured of slate. Abstract and bill out, first, the superficial dimensions, next the runs, and lastly the articles numbered. Describe to roofing gauge, nails used, and number to each slate.

VALUATION. The day-work prices for a journeyman slater vary from 5*s* 6*d* to 6*s*; for a labourer 3*s* 6*d* to 4*s*; and for a boy 2*s*. The value of roofing may be estimated as follows; —

. . . Slates per thousand . . . .
. . . lbs Nails per lb . . . . . .
. . . per Cent Profit . . . . . .
. . . Labour . . . .

MEMORANDA.

	Ft.	ins.		Ft.	ins.
Doubles average	1	1	×	0	6
Ladies „	1	3	×	0	8
Countesses „	1	8	×	0	10
Duchesses „	2	0	×	1	0
Imperials and Patent „ . . .	2	6	×	2	0
Welsh Rags and Queens „ . . .	3	0	×	2	0

Duchess and Countess slating, as most generally used, require respectively to the square 127 and 176 slates and about 250 nails, each square weighing, on the average, 6 cwt.

Inch slab weighs 14 lbs per foot super.

CARPENTER, JOINER AND IRONMONGER.

MEASUREMENT. We may mention that the work of the Carpenter is generally measured cubically, and that of the Joiner superficially. The former includes the rough timber work, or main constructive parts of a building, such as roofs, floors, partitions, etc., necessary for stability and firmness; while the latter comprises the wood fittings and accessories requisite for ornament and convenience. While the carpenter thus requires only as edge tools the axe, adze, chisel and saw, the plane is chiefly employed by the joiner having to deal with boards, instead of the larger timbers necessary to secure the firmness and durability of a structure.

CARPENTER. In practice two different modes of measuring Carpenter's work are in use; first by taking the cubic quantity of material without labour and pricing separately the labour upon it at per square; and secondly taking the cubic contents of the timber and pricing it as, fir no labour, fir in bond, fir proper door case, etc. The first is found practically to pay best in light, and the second in more extensive and heavy work. When the materials and the work on them are tolerably uniform, pricing by the square of 100 feet is usual, and openings to floors, etc., are not deducted on account of the extra labour in forming trimmers, etc. The time for measuring timber in day work is when the carcase is completed, before the boarding

is laid and the plastering executed. The scantlings are taken to the ends of the timbers, the full lengths of the tenons and laps, and no allowance is to be made in quantity for small or difficult work, which is to be priced accordingly and dissected as much as possible. In *Joiner's* work the superficial dimensions only are taken, the tenons, etc., being considered in the price. It is usual to commence with the roof, next taking bond and plates, partitions, floors and other *Carpenter's* work in the manner we shall now indicate.

In measuring *roofs,* commence at the highest point and work downwards. The timbers are taken by the cubic foot and classed according to the amount of labour and waste. The trusses are taken as framed timber in trusses, including binders and ties. Measure length of kings and queens by scantling of shoulders, but deduct pieces cut out for abutment of rafters if above 2′ „ 6″ long by $2^1/_2$ inches thick; deduct 6 inches in the length for waste. Common rafters should be priced at less value than purlins on account of the extra labour of fitting the latter. Wall and templates, as well as poleplates, and lintels, are taken as fir in bond. Gutter plates, diagonals, rafters, purlins, braces and struts, are taken as fir framed. Allow for cutting and waste to hips, deduct half the length of bond running through openings, and allow for length of dovetails and scarfs; and allow generally the bearings one way only in measuring for labour and nails. Ironwork is charged extra. Boarding to roofs is estimated by the square, according to the quality and workmanship, as is also battening for slating and to walls. Gutters and bearers are taken at per foot super, cesspools and drips are numbered, and rolls run.

For *floors,* girders, binders, joists and trimmers are taken as fir framed, and the plates and wood bricks as fir in bond. Price trimmers and trimming joists to include the mortices and tenons. Allow an extra price for sawing, reversing and bolting girders, and also for oak trusses let into bressummers, which may be taken at per foot run. Take strutting at per foot run. "In the measurement and valuation of naked flooring," says Mr. Gwilt, "we may take it either by the square or the cube foot. To form an idea of its value, it is to be observed, that in equal cubic quantities of small and large timbers the latter will have more superficies than the former, whence the saving is not in proportion to the solid contents; and the value, therefore, of the workmanship will not be as the cubic quantity. The trouble of moving timbers increases with their weight, hence a greater expenditure of time; which, though not in exact ratio with the solid quantity, will not be vastly different, their sections not varying considerably in their dimensions. As the value of the saving of a cubic foot is comparatively small to that of the work performed by the carpenter, the whole cost of labour and materials may be ascertained with sufficient accuracy when the work is uniform. When girders occur in naked flooring, the uniformity of the work is thereby interrupted by the mortices and tenons, which become necessary; thus the amount arising from the cubic quantity of the girders would not be sufficient at the same rate per foot, as is put on the other parts, not only because of the difference in size, but because of the mortices, which are cut for the reception of the tenons of the binding joists. Hence, for valuing the labour and materials, the whole should be measured and valued by the cubic quantity, and an additional rate must be put upon every solid foot of the girders; or, if the binding joists be not inserted in the girders at the usual distances, a fixed price must be put upon every mortice and tenon in proportion to their size. The binding joists are not unfrequently pulley, or chase-mortised, for the reception of the ceiling joists; sometimes they are notched to receive the bridging joists on them, and they should therefore be classed by themselves at a larger price per foot cube, or at an additional price for the workmanship, beyond common joisting. All these matters must be in proportion to the description of the work, whether the ceiling joists be put in with pulley mortices and tenons, or the bridgings notched or adzed down."

In *partitions,* the timbers of the greatest scantling should be first measured, if they are not set down at the square. Include the full length of tenons, not measuring from the shoulders. Heads, sills, and door heads should not properly be lumped with the quarters, but priced higher,

as of greater scantling and causing more trouble. For a similar reason the braces should carry a higher price.

Having disposed of roofs, floors and partitions, we have next to consider the remaining details of carpenter's work.

Centring is valued at the square for use and waste, including striking and setting; ribs and boarding should be charged for extra. For groins, vaults, etc., take the depth of the centring by the circumference; and the whole of the materials, although re-used in the course of the works, is to be charged. The angles are to be run. Centring is taken as a running dimension when not more than four and a half inches deep, and often at the foot super. to gauged and other arches; the length for them is taken between the reveals, allowing an inch for the bearing, the depth of the soffite being described. *Turning pieces* are taken at per foot run, but are sometimes numbered, the length of the openings being named. To measure the centring to a cylindrical vault, multiply the circumference of arch by length of vault.

Cradling to entablatures, and *bracketing* to cornices, including plugging, are measured by the superficial foot and the thickness named.

Ashlering is similarly taken, and *sound-boarding* also as a super, taking the dimensions between the joists, and noting if the fillets are single or double.

Battening to walls is taken at the square and described as with plugs, or wall hooks, framed or nailed, or with horizontal backings.

Piles are measured and valued by the cubic foot, and driving them is estimated at the foot run, according to the depth and the nature of the ground. Planking and sleepers are estimated by the yard or square.

Fences to farm buildings are described and priced at per rod of 16 feet, 6 inches, run; or measured and valued, if of fir, as fir framed, with boarding according to its character.

Sawyers charge for their labour by the square of 100 feet super. according to the peculiar character of the timber, the labour on old timber being double. The systems are very various, and no settled rules appear to be adhered to; the charges are often by the load, and for deals, battens, and planks by the dozen.

Scaffolding, ladders, etc., are hired out by the week; and for shoring, one third of the value of the timber is allowed for waste.

JOINER. The rotation to be observed in measuring joiner's work is susceptible of very great variation, scarcely two surveyors following precisely the same mode of procedure. It is also dependent on whether the work is measured from the drawings or the building, as the same order would scarcely be observed in both cases. We believe that, in measuring from drawings, many find it most convenient to take the whole of one item, such as floors, doors, etc., together, and complete the measurement of these before going to other particulars. This process is greatly facilitated if such an order is observed in the Specification of the works, the mode in which this is made out considerably influencing the facility of the labours of the surveyor. Sometimes, however, the joiner's work in each room is taken entirely before proceeding elsewhere; and this will perhaps be found the most desirable rotation in measuring executed works. Take the floor first and work upwards, measuring one after the other, the skirting, wainscoting or dado, (if any), grounds, closets, doors, windows, with shutters, etc. Afterwards take the staircases, partitions, pilasters, and miscellaneous works in the passages and other parts of the house. If there is a shop, this can be taken and completed as the other rooms, the rule being to take *all* the joiner's work in one apartment before proceeding to another.

Floors are measured and valued by the square of 100 feet. If there are mitred borders to the slabs, deduct them and take a run of the borders. If the floor has irregular edges take a run of this by 3 inches, thus producing a superficial dimension for cutting and waste. Describe the thickness of the flooring boards and mode of workmanship.

Skirtings are taken at per foot super. Describe whether level, ramping or raking, in addition to the thickness, mouldings and sinkings; also if straight or circular on plan. If there are narrow grounds take a run of them, and also allow, if requisite, for plugging to walls. Number angles, state if tongued and mitred, and note also the housings. For dados take the superficial dimensions, allowing for rebate in floor, describe them and girt the mouldings. The plinth may be taken separately, and also the surbase moulding of dado, which latter may be inch 1/4 deal keyed and dovetailed dado, ploughed and tongued, or feather tongued, etc., and circular or straight on plan. Number external mitres, note ramps, writhes, etc., and charge grounds.

Chimney grounds, rebated or framed, may be taken at per foot super, naming thickness; sometimes, when narrow, they are run. Framed grounds and *closet fronts* are also taken superficially, with skeleton grounds; note particulars, such as splayed for plastering, circular on plan, beaded edge, mitres, etc.

With respect to *doors* Laxton says, — "the most correct mode of finding the value is to measure the door as originally framed from the bench, which is generally square, or bead butt, or flush and square; then take the sinkings, mouldings, fillets, reeds, etc., as they may occur; value them distinctly, divide the amount by the contents of the door, and add the result to the price of the first framing." Solid door cases are taken at per foot cube as fir proper doorcases, as remarked in carpentry. Take the sill, if any, as the head, allow its full length, and add to length of jambs framed into the sill. Take the doors, with their linings, architraves and grounds, at per foot super, girting carefully the moulded architraves, which mouldings are abstracted under this heading.

In measuring *sashes,* take width between pulley stiles and add 8 inches, and take the height to underside of head from top of sill, adding 7 inches, and describe thickness and moulding, how hung, and all particulars.

If the heads are circular, take the sash and a run of circular frames, but circular heads are often measured square. The fastenings, etc., are numbered. Note if sashes are circular on plan. The frames are taken at per foot super; for sashes hung on hinges, take the frames the same as doorcases. Mouldings up centre of French sashes are run. The grounds and architraves are taken as before directed, as also the elbows, backs, soffits, etc. For boxing *shutters* and back flaps, take the height from elbow cap to clearing piece, adding the rebates to the total width, and give description. Measure boxings from the floor to the top of shutters, adding the width of head; describe it, and if rebated or splayed for plaster. The architrave on the face of the boxings is to be taken, or, if only a moulding is added to the boxings, girt it as a super. or run it. Number ironmongery.

For *Staircases,* take length of step and girt riser and treads, allowing for the thickness of skirting; cylinders are charged extra. Solid quarter round ends to steps and curtail ends are numbered; take super. of strings, describing them; returned nosings are sometimes pieced, if circular charge double straight; run bar balusters and newels, and number gussetts and stays: charge fixing of iron newels. Keep line along centre of top in measuring handrails, run sinking for cores, number mitred and turned caps and nut and screw joints. Half-rails are taken at two-thirds whole rails. The value of handrails depends on whether they are got out of the solid, or in thicknesses glued up.

The following is the mode of measuring staircases recommended by Reid. Take extreme length of tread, including housings, by extreme girt from bottom of front of riser to top of tread, or springing of next riser; describe thickness of step and riser, if fir carriages and how many, if glued and blocked, if moulded or rounded nosing, if mitred to string, if treads are glued and blocked, and if feather tongued. Measure curtail step separately, and describe if quarter round or proper curtail step. To measure winders, take square of space occupied by treads and then

collect risers, which vary according to rake of step; keep winders separate because of price for additional labour.

Number housings for steps and risers and separately for winders. Measure strings by the foot super, taking extreme length, including housings, by width. It will be found correct enough to take length of string board at one foot for each step, to which add length or space, where winders occur, by average width of 12 inches; describe if plain or moulded. Take wreath part separately and describe girt. Describe thickness of strings, and if framed, rebated, beaded, sunk, moulded, and cut to risers. If part is circular describe it. Ramps are taken by the foot run or numbered; the rail by the foot run, taking length on centre; keep separately the straight, ramped, level, circular, wreath, twist, and scroll. Number turned and mitred caps, and nut and screw joints. Run labour on iron core and sinking to rail. Take extreme length of newel, including tenon in floor. Number iron balusters, and run wood balusters.

Pilasters and columns are taken at per foot super. Take the girt by the height, measure in the plinth and take the impost and other mouldings as a super, or a run, and number mitres; run fluting, and price carved capitals. Carvers take 4 times the upper diameter of the shaft of a column for the circumference.

Skylights. Run bars and curbs and describe them; or take some skylights at per foot super.

Water Closets are measured at per foot super; run nosings, and number holes cut in seat, describing the thickness of stuff and the workmanship.

For *Shops*, measure the parts already described as directed. Take the cradling and frieze at per foot super. Describe if with ploughed and tongued blockings, and frieze is keyed, with feather tongued joints, and rebated or tongued to soffite. Measure superficially deal enclosures and the outside shutters; keep separate circular heads, charge 3 times the price of square, and note if circular on plan, $^1/_3$rd extra over straight being charged for every $^1/_4$ inch rise. Run grooves and describe ironwork. Run labour to edges of stall boards and enter girt of moulding. Measure counters superficially, number flaps hung, and note curves on plan. Circular fronts may be charged nearly double the straight.

Boarding to walls and *ceilings* is charged by the square; note if plugged to walls, and charge extra backings and holdfasts.

Framed partitions are taken per foot super. For circular work charge about $^1/_4$th over straight for every $^1/_8$th inch rise. Note plinth and fascias.

Wainscoting is also taken at the superficial foot; run beaded or moulded capping, and enter in all cases thickness of material and particulars of workmanship; with description of fascia and skirting.

With respect to various *framings, linings and deal in thicknesses*, etc., they are measured by the foot super. The value depends on the thickness of the stuff, and whether, if there are mouldings, these are struck on the solid or fixed on. Gwilt remarks of linings, that "the difference of labour between square framed door linings, backs, elbows, soffits, or wainscotings, and door square on both sides, where the panels and thicknesses are alike, arises only from planing the panels and the framing on the other side of the door. If the difference, therefore, per foot, on the rate of a door square on both sides and one square on one side, with any extra work on the other side, be added to the rate of door linings, backs, elbows, soffits, or wainscoting framed square, we shall have the rate per foot for door linings, window linings, or wainscoting, taking the extra work as above considered." Within our limits it is impossible for us to enter upon many such considerations of the value of workmanship, and we can only indicate generally, without minutely describing, the items, and the ordinary modes of measurement. The reader who has followed us thus far will easily infer the manner of taking various works which have not been mentioned; and, indeed, the variety of subjects on which the joiner's skill is exercised, precludes the particulars of them all.

We may, however add that *Dressers, Drawers, Ironing-boards* and *Washing troughs* are taken superficially; *Legs, Runners* and *Sliders*, deal *Water-trunks* and *gutters* by the lineal foot; while a variety of articles too numerous to cite, such as *cantilevers, brackets, pins, boxes, covers*, etc., are numbered and separately charged. Of *Mouldings* generally we may remark, that, if of small girt, they are run, and if larger, taken superficially. Those circular on plan are charged three or four times more than the straight, the increase being in proportion to the rapidity of curve. Housings are pieced. The number of quirks in mouldings considerably affects their expense.

Ironmongery is charged with the work to which it is affixed, 20 per cent profit being allowed to the joiner. *Nails* and *brads* are charged by the hundred although weighed, what are sold for 1000 being seldom above 900. *Screws* are taken at the dozen; all *hinges* per *pair;* ornamental *door furniture* often by the *mortise set,* including three knobs and two escutcheons; *bolts* by the inch or the piece, and *locks* and *latches* also by the piece; *bars* with *two latches* at per inch in length, and *locking bars* by the piece; *lead sash weights* by the pound, and *lines* by the yard; *espaniolette bolts* by the foot; and *sash fastenings,* and a great variety of other articles, by the piece.

The Bellhanger, we may here mention, is allowed 7*s*, 6*d*, per diem and assistant 4*s*. Describe bells, copper and zinc tubing, copper wire, levers, cranks, etc. Church bells are charged by the pound. Charge furniture to pulls in addition per piece.

The general remarks before made on *Abstracting* and *Billing out* apply particularly to the Carpenter's and Joiner's work. First cubes, then supers, runs and numbers. Abstract the Carpenter's work in somewhat of the following order. Fir no Labour, Fir in Bond, Fir Framed, Fir Framed in Trusses, Fir Framed and Wrought, Fir Proper Door and Window Cases, all cubes. Then the supers, Battening, Boarding, Bracketting, etc., Centring, Turning Pieces, etc., Then the runs, Strutting, Rolls, Bearers, Fillets, etc. Then numbers, Wood Blocks and Bricks.

The mode of abstracting Joiner's work is very various; the particular works may be in the following order; — Cube Proper Door Case (if not in Carpenter), Floors, Skirtings, Dados, Jambs and Linings, Doors, Sashes and Frames, Window Finishings, Shutters, Staircases, Pilasters, Partitions, Wainscoting, Deal in Thicknesses: next the runs of Mouldings, Beads, Fillets, Cappings, Balusters, etc.: lastly the numbers of Housings, Standards, Turned Pins, Holes Cut, Newels, etc. The Deals are often kept quite separate; and the Ironmongery can be put on another sheet. Work so priced is to be reduced to the square on the Abstract before Billing it.

VALUATION. 20 per cent profit is allowed to Carpenters and Joiners, who charge on wages of men $2^1/_2d$ in the shilling. The London rate of wages is 30 shillings per week, a little more or less.

Ascertain the value of a cubic foot of fir in the following manner.

Prime Cost per Load at yard . . .
Cartage . . . .
Sawing into Scantlings . . . . .
One Tenth for Waste . . . .
Profit, 20 per cent . . . . ______

We do not affix the figures for the reason previously mentioned. As Gwilt remarks; — "It is out of the question to give a notion of any fixed value, because it must necessarily vary, as do materials and labour; hence, no tables or price books are ever to be depended upon; they gull the unwary, and mislead the amateur who consults them." The same author observes; — "Where the measurement is for labour and materials, the best way is, first to find the cubical contents of a piece of carpentry, and value it by the cubic foot, including the prime cost, carting, sawing, waste, and carpenter's profit, and then add the price of the labour, properly measured, as if the journeyman were to be paid."

To ascertain the value of Deals or Battens when the prime cost is known, put the particulars as follows; —

Prime Cost per C. . . . .
Cartage . . . .
$^{1}/_{10}$th for Waste . . . .
20 Per Cent Profit . . . .

The price of deals per foot super will be increased, or lowered, 1*d* per inch in thickness for every rise or fall of £ 9 per C. The table below, from Gwilt's Encyclopædia, shows the prices of deals at £ 30 per C.

Price per Hundred.	Thickness.	10 ft. long each.	12 ft. long each.	14 ft. long each.	Per foot run.	Per foot super.
	In	*s d*	*s d*	*s d*	*s d*	*s d*
	$^{1}/_{2}$	1 „ $4^{3}/_{4}$	1 „ 8	1 „ $11^{1}/_{4}$	0 „ 2	0 „ $2^{1}/_{2}$
	$^{3}/_{4}$	1 „ $7^{1}/_{4}$	1 „ $11^{1}/_{4}$	2 „ 3	0 „ $2^{1}/_{4}$	0 „ 3
	1	2 „ $0^{3}/_{4}$	2 „ $5^{3}/_{4}$	2 „ $10^{1}/_{2}$	0 „ 3	0 „ $3^{3}/_{4}$
£ 30.	$1^{1}/_{4}$	2 „ $6^{1}/_{2}$	3 „ $0^{1}/_{2}$	3 „ $6^{1}/_{2}$	0 „ $3^{1}/_{2}$	0 „ $4^{3}/_{4}$
	$1^{1}/_{2}$	2 „ $11^{3}/_{4}$	3 „ $6^{3}/_{4}$	4 „ $1^{3}/_{4}$	0 „ $4^{1}/_{4}$	0 „ $5^{1}/_{2}$
	2	3 „ 11	4 „ 7	5 „ 4	0 „ $5^{1}/_{4}$	0 „ 7
	$2^{1}/_{2}$	4 „ $8^{1}/_{2}$	5 „ $8^{1}/_{4}$	6 „ $7^{1}/_{2}$	0 „ $6^{1}/_{2}$	0 „ $8^{3}/_{4}$
	3	5 „ $5^{3}/_{4}$	6 „ 7	7 „ $8^{1}/_{4}$	0 „ $7^{1}/_{2}$	0 „ 10

At Pages 150. 163. 165. 201. 203. 206 of "The Builder's Practical Director" additional Tables and Memoranda will be found.

MEMORANDA.

A load of timber contains 50 cubic feet.
120 Deals go to the hundred.
100 Feet super. go to a square of boarding or flooring.
400 Feet super of inch $^{1}/_{2}$ deal go to one load.
600 „ inch „ „
100 12 ft. 3 ins deals, 9 ins. wide, go to $5^{2}/_{3}$ loads.
100 12 ft. $2^{1}/_{2}$ ins „ „ „ $4^{1}/_{2}$ loads.
Battens are 7 inches wide.
Deals „ 9 „ „
Planks „ 11 „ „

A deal when reduced is 12 feet long, 11 ins. wide, and $1^{1}/_{2}$ in. thick.

45 Cubic feet of ash equal 1 ton.
51 „ beech „
66 „ deals „
60 „ elm „
64 „ fir „
35 „ mahogany „
39 „ oak „

With 12 feet deals a square of flooring requires; —

13 boards if wrought and laid folding.
$13^{1}/_{2}$ „ if laid straight joint.
14 „ „ and ploughed and tongued.

Or to the square there are required; —

20	12 feet boards to a	5	inch gauge.
16	„ „	6	„
14	„ „	7	„

Materials for deal mouldings about equal the labour. 4 Score of 6 feet, 5 score of 5 feet and 6 score of 4 feet cleft oak pales go to the hundred.

MASON.

MEASUREMENT. In measuring Mason's work, take first the cubic contents of the stone, as it comes from the banker (the bench on which the work is prepared and squared), without deduction for subsequent waste, and allow for half sawing on each face on which this has taken place. Then measure and value, at per foot super., the labour of plain, sunk and moulded work. Fluting the shafts of columns, grooves, joints, throating, rebating, etc., are all valued at the lineal foot. A plain face is allowed to each joint, but not more than one to a 3 feet length. For large stones an extra price is allowed — if more than 6 feet long they are taken as scantling — and hoisting is charged for work above 40 feet from the ground, the height being noted. Stones under 3 inches in thickness are taken superficially as slab, describing the work; those above 3 inches in thickness are cubed and the labour added. Sawing should be taken on all sides of a stone, except when part is left rough; it is described as half sawing, the other half being charged on the corresponding stone. When one stone is set on another, a plain bed is taken, but if the stone is set on brickwork, it is omitted. Where the stone shows, plain work rubbed is taken to the front, top, and return ends, and plain work only to joints. Of course, if the work is only tooled or otherwise executed, it is so taken. Run chamfers, joggle joints, etc., and number holes cut, notches, mitres, cramps, joggles, and dowels. Mr. Laxton recommends in his Price Book, as more equitable than the present system, — "To add to the price of the stone the labour of setting, hoisting and scaffolding per foot cube. To allow for half sawing upon each face that has been sawn. If the face be worked, add to the sawing the price of plain, sunk, or moulded work, as the case may be, exclusive of setting. The price of labour to the two faces of beds and joints to be taken at the same price as plain or sunk work for one face, in addition to the sawing." In all work of a superior description in which moulded, sunk, or other labour could not be executed by applying a mould, without making a plain face, this must be charged first, and the rest of the work which followed, if girt as it is finished. Dobson observes in his work on measuring, that, — "as bevelled or irregularly formed stones cannot be converted without more waste than square ones, the dimensions should be taken so as to make a fair allowance for such additional waste, particularly as the solid contents of all the different descriptions of Portland Stone, whatever shape the stones may be worked to, are abstracted under the same head, (viz cube Portland) and therefore should be of the same value; but which cannot be the case, unless the extra waste in the bevelled stone, etc. is allowed for in taking the dimensions. When this is done, it is only requisite, in estimating the prime cost, to calculate for the waste, as if all the stones in the building were cut and worked square. If this method were not adopted, it would be requisite, in ascertaining its real value, to make so many different heads in the abstract for cube Portland as there are different shaped or bevelled stones, accurately describing each; when the calculations for waste, and of course the price, must vary according to each particular form, the trouble of which would be endless and without any advantage; indeed, it would come to the same thing, viz, making the necessary allowances for waste, according to the form of the stone. Bevelled or arched stones should be taken about one-sixth above the mean dimension, to allow for waste."

In Scotland and many parts of England, when the measurement is for labour only, the girt of the exterior of the house is taken for the length of the work, and the height for the width. Of

course, if the walls are of different thicknesses, they must be measured separately. If there are plinths, strings, cornices, pilasters and breaks, the tape is made to girt them in taking the large dimensions, but the system is evidently exceedingly unscientific, leading to vague and uncertain results. The practice of measuring rough stonework by the perch of 18 feet super. is usual in the West of England. The walls are reduced to the thickness of two feet, by multiplying the superficial contents by the number of inches in thickness, and dividing by 24. Sometimes the work is valued at the solid perch of 36 feet cube. Thy walling should be measured and an addition made for any extra labour, although it is common to girt the quoins and projections for this; small apertures are not usually deducted. To value the work properly, calculate the prime cost of the stone, carriage, hoisting and labour, together with the cost of the lime, etc., delivered. Elsam gives in his "Builder's Assistant" the following method of finding the number of perches in *rough walling*. "If the wall be of the standard thickness, that is, twelve inches high, eighten inches thick, and twenty one feet long, divide the area by 21 and the quotient, if any, is feet. If the wall be more or less than eighteen inches thick, multiply the area of the wall by the number of inches in thickness, which product, divided by 18, and that quotient by 21, will give the perches contained.

Example. A piece of stoneware is forty feet long, twenty feet high, and twenty four inches thick, how many perches are contained in it?

```
        40 length
        20 height
      ----
       800
        24
      ----
      3200
      1600    21)  P.   F.   I.
  ---------
  18) 19200  (1066 (50 ,, 16 ,, 8
      18      105
     ----     ----
       120     16
       108
      ----
       120
       108
      ----
        12 = 8 inches.
```

For *Facing*, or Ashlering, measure plain work to the face, joint, and bed, and one vertical face and the bed to bonders. If the facings are above three inches thick, the stone is taken cubically as above, but, if less, as a super, or slab, and one joint and bed is taken as plain work; sunk work is taken to rustics; and to windows with semicircular heads, sunk work to the arch joints, plain work circular to the soffits, and plain work to reveals. Note dovetails, plugs, lead, etc.

We shall next indicate generally the mode of measuring various details of masonry.

Columns. After the cubic quantity is ascertained, all cylindrical work is girt and considered equal to plain work twice taken. Reid says; — "first take the quantity of the stone, then take two sides of the solid stones, and to the columns their beds for plain work; the height and circumference should then be taken as circular sunk work, with their several plain faces or beds; having finished the shafts of the columns, then proceed to measure the bases and capitals, first taking the solid stones, and subsequently the plain, sunk and moulded works, but if the capitals should be Ionic, Corinthian or Composite, then take as nearly as possible the presumed solid contents of the stone, and ascertain the quantum of time consumed in carving, which, being added to the worth of the stone, with suitable profits on the workmanship, will constitute the value, in which should be included labour of fixing, hoisting, etc."

For *Architraves*, take first the cubic contents of the stone, plain work to bed and end, sunk work to joggles, and moulded work to the faces.

For *Cornices*, take similarly the cubic contents, plain work to beds and joint, half plain face to back, sunk work to joggles, run grooves, and girt moulded work. No bed to be taken if cornice is on brickwork.

For *Stringcourses*, cube the stone, plain work to bed and joint, sunk work where it exists, run throating, and take mouldings, if any.

For *Plinths*, cube the stone, and take plain work to the sides and top, with moulded work, if any.

For *Coping*, cube the stone, take plain work to the top, edges, and undersides which show, also to one joint in every 3 feet, sunk work to top, if so, and run of throating.

For *Curbs*, cube the stone, take plain work on all sides which show and to one end in every 3 feet. If the top is curved take circular plain work; no bed to be taken.

For *Sills*, cube the stone, plain work to parts which show, sunk work to top, and run throating.

Chimney Pieces are usually priced at so much each, but the work may be taken as it may happen to be; take the labour on the edges at per foot run, or add an inch to the dimensions for extra labour to Portland stone, and $^3/_4$ inch to marble.

Staircases. Take the flyers, where splayed on the back, the full length and width by three-fifths the depth of the riser, allowing for waste in getting two steps from one block of stone. If the extreme length of winders is taken, including the letting into wall by the mean width, this multiplied by the clear height will give the cubical content.

Laxton says, — "Measure spandril steps the extreme width from the nose of the tread to the acute end of the angle by half the riser, taking from top to tread (front of nosing) to the acute end of angle downward. To solid steps, if laid on brickwork, take the plain, sunk or moulded work on the face of the tread, riser, and ends only, and no bed to be allowed; but if laid on stone, half a bed to be taken. In spandril steps take the plain, sunk, or moulded work to the tread, riser, and end, and if the underside be worked, to be taken as plain; the underside of the winders to be taken as circular sunk." In open staircases, take the underside of winders as circular plain work, that of fliers as plain work, the top of treads generally as plain work, and the ends and fronts of risers as moulded, noting all rebates, pinnings, etc. The stone is, of course, first cubed, taking plain work to the top, soffit and part fronting wall, and moulded work to this and face of steps. Number holes cut for balusters and the steps pinned into the wall.

For *Landings*, take the cubic contents of the stone, plain face to top, bottom and front, and also moulding, if any, sunk work to joggles, and run of cutting and pinning. If landings are above six feet long an extra price is charged.

Take *Balcony bottoms* in a similar manner.

For *Square Steps* generally, take first the cube stone, then plain work to the faces which show, and sunk work to rebates.

Paving is usually measured and priced per superficial foot, noting the jointing, and whether it is only self-faced, tooled or rubbed. All stones under 3 inches thick may be taken similarly. *Pavior's* work is estimated by the superficial yard.

All cramps, joggles, dowels etc. are to be numbered, and the letting in is to be noted, whether in lead or cement; copper cramps are taken at the lb.

York stone paving and landings are taken per foot super; *sills, curbs, and copings* at per foot run; and *steps* and *sinks* are often numbered.

Kentish Rag Stone is taken at the foot cube, and the labour per cubic yard; rough rag is sold by the ton; galleting the joints and hammer-dressing is valued by the superficial foot and hassock per foot cube.

Marble is sold by the foot cube and in slabs for chimneys, etc., at the foot super.

Granite is taken at the foot cube, *Delabole slate, Caithness Flags, Firestone, Castle Hill* and *Purbeck* at the foot super; curbs of various stones are often run.

Abstract and bill out the cubes first, then the superficies, running measures and numbers. Place first Rough Stone Walling. Next Cube Portland. Then the labour on it, Plain Face, Sunk, Moulded Works, etc. Then the Slabs. Afterwards the Yorkshire Stone. Keep separate the Marble; and also under each heading of different stone, the running dimensions and numbers.

VALUATION AND MEMORANDA. We have sufficiently indicated above the principles of valuation, viz., by first taking the cubic quantity of stone and adding the cartage, hoisting and labour. The wages may be taken, Mason 6*s*, Labourer 3*s* 6*d*, Polisher 4*s*, Carver 10*s* 6*d* per diem. To give the prices of materials would only tend to mislead.

$15\frac{1}{2}$	Cubic feet of	Portland	weigh 1 ton.
$16\frac{1}{2}$	„	Bath	„
$14\frac{1}{4}$	„	York	„
13	„	Granite	„
70 super	„	$2\frac{1}{2}$" York	„

At Pages 235. 247. and 255. of "The Builder's Practical Director" will be found much additional information.

PLUMBER.

MEASUREMENT. The value of Plumber's work is dependant on the cost of lead per cwt, and the addition to this of the expense of labour. Take the superficial dimensions of the lead on flats, roofs, and to the gutters, hips, ridges, flashings etc., note whether cast or milled, weight, or number of lbs. to the foot super, and run soldering, joints and angles. Keep separate the work to gutters and flats, hips, ridges, and flashings. Run pipes and socket pipes, note diameters, weight per foot super of lead used, and number joints; remark if *drawn* lead pipe. Number cocks, balls, bosses, washers and plugs, brass grates, spindle valves, air traps, etc. Pumps, with bucket and sucker, and also hydraulic pumps, with lever, carriage, sling, etc., are charged at so much each, as are also water closets, with their fittings, basins, cranks, D traps, ball levers etc. Pump rods for hydraulic pumps are charged per foot lineal. Window lead is charged by the cwt. Abstract the lead under the headings of the number of lbs. to the superficial foot, and reduce it to cwts. in the Abstract for Billing. Take next the running dimensions and the numbers.

VALUATION AND MEMORANDA. Plumber 6*s* per diem, Labourer 4*s*. To ascertain the weight of lead, square the dimensions, multiply product by the number of lbs. weight of lead to the foot super, when dividing by 112 will give the number of cwts.

The following are the weights of pipes of good quality per foot run; —

$\frac{1}{2}$	Inch Pipes	weigh	$1\frac{3}{4}$	lbs	per lineal	foot.
$\frac{3}{4}$	„	„	3	„	„	„
1	„	„	$4\frac{1}{2}$	„	„	„
$1\frac{1}{4}$	„	„	$5\frac{1}{4}$	„	„	„
$1\frac{1}{2}$	„	„	7	„	„	„
$1\frac{3}{4}$	„	„	$7\frac{3}{4}$	„	„	„
2	„	„	$9\frac{1}{2}$	„	„	„
$2\frac{1}{2}$	„	„	11	„	„	„
3	„	„	$18\frac{1}{2}$	„	„	„

The next Table shows the comparative weights of lead per foot super.

.10 Inch	thick	equals	5.89	lbs	per foot	super.
.11	„	„	6.48	„	„	„
1/9	„	„	6.56	„	„	„
.12	„	„	7.07	„	„	„
1/8	„	„	7.37	„	„	„
.13	„	„	7.66	„	„	„
.14	„	„	8.25	„	„	„
1/7	„	„	8.42	„	„	„
.15	„	„	8.84	„	„	„
.16	„	„	9.43	„	„	„
1/6	„	„	9.83	„	„	„
.17	„	„	10.03	„	„	„
.18	„	„	10.61	„	„	„
.19	„	„	11.20	„	„	„
1/5	„	„	11.79	„	„	„
.21	„	„	12.39	„	„	„

COPPER SMITH.

MEASUREMENT. The work of the Copper Smith in covering roofs, domes, etc., is to be measured and valued on a similar system to that of the Plumber. The material is found too expensive for general use in roofing, although it was one of the first metals employed in ancient times. It is estimated by the foot super, according to the number of ounces. It is very light; for flats and gutters 12 to 18 oz. copper is employed, and sometimes 20 oz. to flats and domes. Copper gutters and pipes are run, their diameter and weight should be noted, and if, as they are sometimes, tinned. Cistern heads, spikes and screws, with copper ties, coppers for washing, etc., are numbered. Copper cramps, dowels, bolts, etc., of course come under this heading, as well as copper wire work, estimated at per foot super. Copper wire is charged by the lb.

ZINC WORKER.

MEASUREMENT. The two above trades have experienced a considerable shock from the introduction of sheet zinc into this country by the Vieille-Montagne Company, and the material has, to a certain extent, from its exceeding cheapness and lightness, superseded both lead and copper. The Plumbers formerly supplied zinc articles and laid the material on roofs and flats, but the increasing demand has given rise to a distinct business, specially devoted to the manufacture of the metal into a vast variety of articles. Zinc sheets are 4′ „ 0″ >< 1′ „ 2″, 7′ „ 0″ >< 2′ „ 8″, and 7′ „ 0″ >< 3′ „ 0″; and the gauges are No 10 weighing 14 oz. to the superficial foot, 11 weighing 16 oz., 12 weighing 18 oz., 13 weighing 21 oz., 14 weighing 24 oz., 15 weighing 27 oz., and 16 weighing 30 oz. Zinc 21 or 24 oz. to the foot is adapted for gutters, and 27 oz. for flats.

The mode of measurement, abstracting and billing is similar in principle to that of Plumber's work already described. Girt the flat, roof, etc., and note weight of zinc and character of workmanship; take super. of skylights and fanlights; or for skylights measure once and a half the superficial area on plan for the quantity; take as square circular lights.

Number lights to open and ventilators, with pulleys, lines and weights. Pipes and gutters are run, remarking the diameter and gauge and numbering brackets; No's 13 and 14 are good gauges for pipes and gutters. Chimney pipes are also taken at the lineal foot. Zinc nails for

roofing, etc., by the pound of about 150. The wire is of various sizes from 1 to 24 the stoutest. Take solder at the lb. Abstract under the different weights, placing first the supers, then the runs, and lastly the articles numbered.

MEMORANDA. Zinc worker 5*s* 9*d* per Diem, Labourer 3*s* 9*d*.

The following is a Table of Zinc Wire Gauges with the weights per square foot.

			lbs.		oz.		
Gauge	10	. . .	3	„	11	Weight per	Square Foot.
„	12	. . .	3	„	8	„	„
„	13	. . .	3	„	5	„	„
„	14	. . .	3	„	0	„	„
„	15	. . .	2	„	11	„	„
„	16	. . .	2	„	3	„	„
„	17	. . .	1	„	15	„	„
„	18	. . .	1	„	10	„	„
„	19	. . .	1	„	8	„	„
„	20	. . .	1	„	6	„	„
„	21	. . .	1	„	4	„	„
„	22	. . .	1	„	1	„	„
„	23	. . .	0	„	15	„	„
„	24	. . .	0	„	13	„	„
„	25	. . .	0	„	11	„	„

It may be useful to observe that a sheet of zinc 4 ft. $\times$ 1 ft. 2 ins. covers $4^2/_3$ square feet; one 7 ft. $\times$ 2 ft. 8 ins. $18^2/_3$ square feet; and one 7 ft. $\times$ 3 ft. 21 square feet. 100 square feet of No 15 gauge, 24 oz. to the foot, weighs 150 lbs. The tenacity is 109.8 to lead 27.7; and the dilatibility $^1/_{140}$ to lead $^1/_{396}$ and iron $^1/_{819}$.

PLASTERER.

MEASUREMENT. Measure plastering on brickwork from upper edge of grounds to two thirds of the height of the cornice, and similarly for on lath; for stucco take one third the height of cornice. In taking ceilings, deduct one projection of the cornice on two sides of the room; but if there are brackets to the cornice, take the ceilings quite clear of the cornice and also the walls in a similar manner. Take coves to cornices as super. dimensions, and keep them separate, adding one inch to girt of cornice for return of mould towards the cove. Take floating to friezes, soffits, etc., whether plain or enriched and keep them separate. Roughing in and dubbing out are only allowed when work is very irregular, and scaffolding when the hawk cannot be served from floor. Take reveals to windows at per foot run.

Cornices under 6 inches girt are run; those 6 inches girt and above are taken as super cornice. Take size of room and one projection in and out by the girt. If there are more than four angles to the apartment, charge each extra one per foot run extra of cornice; or number all angles above one in 10 feet. Number stopped ends. Allow a screed in running cornices to old ceilings.

Keep all enrichments distinct: run them, note girt, and number pateræ. Run also arrises, quirks, beads, mouldings to panels, raised margins. Enter, of course, description of ornaments, whether, *carton pierre, papier maché*, etc.

Circular enrichments and mouldings are measured one face in and out. Modelling is not charged when the length is above 60 feet.

Floors of lime and hair are estimated by the square, noting thickness, also pugging. External cement work is estimated by the yard, facias and mouldings by the foot super, and arris edges are run. Whiting and colouring are reduced to yards superficial.

In Abstracting keep separate the plastering, stucco, and cement work, externally and internally. First put the Superficial Yards, beginning with the least expensive work, then the Superficial Feet. Next the Whiting and Colouring. Afterwards the Running dimensions, and lastly the Numbers. Bill out in a somewhat similar order.

VALUATION AND MEMORANDA. Plasterer per Diem 5*s* 9*d*, Labourer 3*s* 9*d*, Boy 1*s* 9*d*, Modeller 10*s*. 20 per cent profit on materials.

For 100 Yards of render, set, it is requisite, to have $1^{1}/_{2}$ hundred of lime (33 feet cube to the hundred), one double load of river sand (2 cubic yards, or 36 heaped bushels), and 4 bushels of hair. To execute the work it will take 1 plasterer, 1 labourer and 1 boy three days. For 130 yards of lath, plaster and set, it is requisite to have 1 load of laths, 10,000 nails, $2^{1}/_{2}$ hundred of lime, $1^{1}/_{2}$ double load of sand, and 7 bushels of hair; 6 days will be occupied by the plasterer, labourer and boy.

1 Bushel of cement and 1 of sand will cover 3 square yards of the ordinary thickness.

Laths are priced by the bundle and load, hair per bushel, lime and hair per hod, and lime by the hundred and bag. Roman and Portland cement by the bushel, the former in 5 bushel, and the latter in 4 bushel casks; Martin's cement in bushels of 72 lbs. Keene's in 5 bushel casks, Parian in 4 bushel casks, and John's cement and mastic by the cwt. The cements are also charged by the bushel, plaster by the rod and bag, nails per thousand, size by the gallon and firkin, whiting per dozen, size and whiting per pail, blue black per lb, linseed oil per gallon, wax for moulds per lb, and carting by the single and double loads.

SMITH AND FOUNDER.

On the Ironmongery department we have spoken under Carpenter and Joiner.

MEASUREMENT. Girders, columns, story posts, gratings, balconies, furnace bars, doors and frames, sewer grates, lamp posts, railing bars, plates for floors, wrought bars, hoop and sheet iron, and generally the more heavy description of work, are charged by the ton or cwt. Patterns, moulds and fixing are extra.

Ties, straps, bolts, ties, shoes, etc., to floors and roofs, wrought iron chimney bars, balusters and hand-rails, area gratings, hook and eye strap hinges, chains for posts, fancy-rails, casements, brackets, shoes to piles, cradle bars, iron chain bars, drawn balusters, gates, chevaux-de-frize, guard bars, sash bar, bars for shop shutters, etc., wrought hurdles, wrought and cast iron furnace work, wrought iron doors, etc., are charged by the pound.

Cast iron doors, revolving shutters, wrought fanlights, fly wire, etc., are charged per foot super.

Balconies, railings, copings, iron bar, skylight bars, etc., are charged by the lineal foot, and pipes and guttering by the yard run.

Cast iron steps and risers are charged, according to the diameter and character, by the step, and by the foot perpendicular.

Cantilevers, brackets, air traps and bricks, pumps, W. C. traps, copper hole doors and frames, soot doors, iron mangers, racks, posts, saddle brackets, gutters, etc., for stables, smoke jacks, cowls, coal plates, scrapers, etc., are charged singly. Iron roofing and enclosures are taken at the square of 100 feet.

It will thus be perceived that many articles are taken in various ways.

Abstract and bill out items on the principles before named, placing first the heavy and simplest works, and next supers, runs and numbers, but the order is often susceptible of advantageous variations.

MEMORANDA. The wages of the Smith per diem may be set down at 6*s*, and the Labourer at 4*s*.

To ascertain the weight of a girder, find the number of superficial feet and set them down at their respective thicknesses; reduce them to inch thicknesses, and multiply the total by 40 lbs, (the weight of a superficial foot one inch thick), which, divided by 112 will give the weight in cwts.

To ascertain the weight of wrought iron, take it at 5 lbs per foot super, one eighth of an inch thick.

A cubic foot of cast iron weighs about				450
Do.	wrought	„	„	480
Do.	closely hammered	„		490

TABLE OF WEIGHTS OF BAR IRON.

Side of Square. Ins. Eights.	Light Hammered. lbs. oz.	Close Hammered. lbs. oz.
0 „ 4	0 „ 13	— „ 13
0 „ 5	1 „ 4	1 „ 5½
0 „ 6	1 „ 13	1 „ 15
0 „ 7	2 „ 8	2 „ 10
1 „ 0	3 „ 5	3 „ 7
1 „ 1	4 „ 3	4 „ 5½
1 „ 2	5 „ 3	5 „ 6
1 „ 3	6 „ 4	6 „ 8½
1 „ 4	7 „ 8	7 „ 11¾
1 „ 5	8 „ 12	9 „ 1
1 „ 6	10 „ 2	10 „ 8½
1 „ 7	11 „ 9	12 „ 1½
2 „ 0	13 „ 4	13 „ 12
2 „ 1	14 „ 15	15 „ 8
2 „ 2	16 „ 12	17 „ 6
2 „ 3	18 „ 10	19 „ 6
2 „ 5	22 „ 12	23 „ 10
2 „ 6	24 „ 15	26 „ 0¼
2 „ 7	27 „ 4	28 „ 8½
3 „ 0	29 „ 11	30 „ 16
3 „ 1	32 „ 4	33 „ 9
3 „ 2	34 „ 14	36 „ 4
3 „ 3	37 „ 10	39 „ 5½
3 „ 4	40 „ 8	42 „ 2

GLAZIER.

MEASUREMENT. Measure the glass between the rebates; all irregular panes are to be taken square, the extreme lengths. Allow a sum for scaffolding if required.

Glass is to be priced at per foot super, noting the kind and the quality. Thus Crown glass may be first, second, third, or fourth; horticultural and fluted glass 13, 16 or 21 oz. per foot super; glass slates and tiles from $^1/_{10}$th to $^1/_2$ an inch thick; sheet glass 16, 21, 26 or 32 ounces to the foot super; patent plate No's 13. 17. 21 or 26 respectively 13, 17, 21 and 26 oz. to the foot super, and $^1/_{16}$, $^1/_{12}$, $^1/_{10}$ and $^1/_8$th of an inch thick; Hartley's rough and fluted plate $^1/_4$, $^3/_8$, $^1/_2$, $^3/_4$, and 1 inch thick; British plate $^3/_{16}$, $^1/_4$ inch, and upwards; coloured glass about 16 oz. to the superficial foot. Silvering costs about $12^1/_2$ per cent under £ 50 value, and 20 per cent above.

Abstract and bill out the cheapest glass first, gradually rising in cost. First supers, then runs and numbers.

MEMORANDA. The wages of the Glazier may be set down at 5*s* 9*d*. Cleaning windows is charged by the dozen squares, also puttying them. Putty is sold by the lb.

A Crate of Crown Glass contains;

12	Tables	of the	first	quality
15	„	„	second	„
18	„	„	third	„
18	„	„	fourth	„

10 Feet super may be estimated as the average quantity of glass that can be made available from each table.

PAINTER.

MEASUREMENT. It is very general in estimating the work of the Painter to take the quantities as measured for the Joiner's work, so far as the painting relates to his department, and add about a sixth of the total quantity for the mouldings and edges. To arrive exactly at the value of painter's work, it is necessary to make minute inquiries respecting the precise quantities of turpentine, oil and white lead really requisite, to cover with so many coats a certain number of yards, the character and the age of the material having also to be taken into account. Unless the mixtures are properly graduated and proportioned, the consequences will soon be visible, and the work be again required to be performed within the period, for which it should have endured. Many woods last longest without paint. Of course, if it is applied to unseasoned timber, its decay is hastened from the confining process, the wiry, frizly fibres of oak and fir being often found more effectual than paint in warding off the heat of the sun and the penetration of rain.

Painters's work, we may remark generally, is taken at the superficial foot, adding all edges, sinkings, projections, girts, etc. Skirtings, cornices, and all works cut in on both edges, are run; other work is taken superficially, and the measurement is to be made wherever the brush goes. Railings and balusters are measured on both sides as flat work, to allow for trouble of painting round bars, etc.; but if there is much ornament, take once and a half or twice for each side; reduce it to yards square. If on a ground there are moulds cut in differently, take a run of them in addition. Handrails are measured with the balusters and run in addition for graining. Take all ornamental work as common, and add to this the superficial or running dimensions of ornament.

In measuring *doors*, add 2 inches for panels, and 2 inches for girt of architrave, and then take linings, allowing for rebates.

In taking *windows*, allow similarly for architrave, mouldings, etc.; take the shutters, adding for edges and mouldings; and frames and squares are priced at so much each.

The common colours are stone, lead, black, white, and chocolate; an extra price is to be allowed for other colours, as for imitations and varnishing.

The following articles are taken at per foot run; —

Cornices, skirtings, and strings not more than 12 ins wide, handrails and newels, reveals, gutters, water-trunks, bars and frames to skylights and hothouses, rails, sides and steps to ladders, stair margins, mouldings cut in. Number frames, chimney pieces, plain and boxed, scrapers, and price squares per dozen.

Letters are measured in height and charged per inch run.

Abstract the supers in the first place under the head of the number of oils; then the extra colours, imitations, varnishing, etc.; then the runs; lastly the numbers. Carved work may be kept by itself, or put down under the headings at so many coats. Bill in a similar rotation.

VALUATION AND MEMORANDA. 6*s* per diem may be set down for the painter. Colour and putty are sold by the pound; brushes, tools and pots at so much each. 20 per cent profit is allowed on materials.

Mr. Dobson says that 45 yards of work, first coat, including knotting, stopping, and every preparation requisite for the second coat, will require 5 lbs white lead, 5 lbs putty and litharge, 1 quart oil; second and following coats 5 lbs white lead, 1 quart oil. Partington gives the expense of stone colour and the quantities of materials as follows.

	£	s	d
Lime water, 4 gallons	0 ,,	0 ,,	4
Whiting, 112 pounds	0 ,,	2 ,,	4
White lead, ground, 28 lbs at 6*d* . .	0 ,,	14 ,,	0
Road dust, 56 lbs	0 ,,	0 ,,	6
Prepared fish oil, 2 gallons	0 ,,	6 ,,	0
Incorporated oil, $3^1/_2$ gallons . . .	0 ,,	7 ,,	0
Linseed oil, $3^1/_2$ gallons	0 ,,	15 ,,	9
Weighs 293 lbs.	£ 2 ,,	5 ,,	11

Fit for use, this is not quite two pence per pound.

Letter writing, we may mention, is charged by the inch run, the height of the letter being measured, and multiplied by the total number. Shadowed letters are a halfpenny per inch more than plain ones, and gilt letters treble.

Gilding is executed either through a medium of water or oil. The latter is chiefly used in the decoration of houses. A book of gold contains 25 leaves, $3^1/_2'' \times 3^1/_4''$, or 1′ ,, $7^1/_2''$ super, covering about one foot square of plain work. The gold is of various thicknesses.

Gilder 7*s* per diem, and gold leaf about 2*s* per book.

PAPER HANGER AND DECORATOR.

MEASUREMENT. Paper is charged by the piece, the price varying, according to the number of blocks used in printing it, the quality, and the colours. Hanging is charged from about 8*d* to 1*s* per piece. Borders are charged by the dozen yards, and hanging them the same. Pumicing, sizing and preparing walls, canvass lining, sizing and varnishing, are all charged by the piece. India rubber paper for damp walls costs about half a crown per piece. Crimson flock, satin and gold, panelled decorations, embossed papers, etc., cost proportionately more than common papers, as their quality and the trouble of hanging is increased. Run mouldings, etc. Abstract paper according to its quality, placing first supers, then runs and numbers, and similarly bill out.

MEMORANDA. The length of a piece of paper is 12 yards by 21 inches wide (or 20 when hung), thus containing 63 superficial feet or 7 yards. Allow for waste 1 piece in 7. 36 feet run, or 12 yards, equal a dozen borders.

A French piece of paper contains 4 yards square. Dividing any number of superficial feet by 5 will give the number of yards of paper requisite to cover the walls of a room; by dividing this by 12 we have the number of pieces. Odd yards are charged as a piece.

Take *Distempering* by the yard, note if done once or twice, if with one coat of colour in turps or oil, and give description. Run lines and mouldings to panels, ceilings, etc.; but take cornices distempered at per foot super. Number ornaments, honeysuckles, etc., at angles.

We have now completed our slight sketch of the measurement and valuation of Artificers' work. To enter more minutely into the subject, to define the numerous variations in practice,

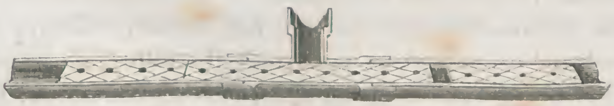
STABLE FITTINGS.

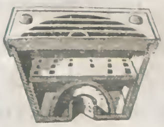
PLATES 48. 49.

We have not hitherto, in the course of this work, spoken of Stabling, but now propose to make some remarks on the subject. Plate 48. contains plans for a two-stall stable, with loose box, coach house, harness room, loft, and bed room for groom. The arrangement is compact and decidedly the most economical that can be adopted; and on Plate 49, is a section, showing the exceedingly simple character of the construction. The elevations are necessarily so destitute of ornamentation, and at the same time so illustrated by the plans and section and thus readily comprehended, that we have not deemed it essential to give them. On Plate 49, are also on the right hand side two details, modified from a foreign work, showing the mode of constructing the fittings of Stables very usual in France.

It is of the utmost importance to keep stables dry and airy, and their situation should therefore be chosen with especial attention to these requisites, as dampness will be certain to give rise to disease in the horses. If there is any suspicion of it, or the foundations are bad, concrete should be used; a layer 6 inches thick being spread over the whole surface of the ground, and the walls being erected on it, twice the width of the lowest course of footings, and one to two feet deep.

The paving will depend on the locality. Stone pebbles laid in sand and gravel, with channels for drains formed in the same with bricks on edge lined with cement, are cheap enough. Punned clay is common for coach houses. The surface of yards may be formed to currents, and coated with one layer of coarse and one layer of fine gravel, well beaten to a hard consistence. Grey stocks on edge in mortar cost about 3 shillings per square yard, and Dutch clinker paving, which is extremely durable, 10*s* 6*d*. In the south of England Moore stone is used and found to be excellent. Chalk puddle primed in, faced flints, clay and smith's ashes, and slate cuttings set edgeways in cement, are all good. Wood blocks are too absorbent. Kamptulicon is much used by the government in cavalry stables. Stoneware pipes, gullys and traps are good for drainage. The iron stable guttering, traps and pots of Cottam and Hallen, are great improvements; they are shown in the margin, the guttering costing 2*s* 6*d* per foot run, and T pieces 3*s* 6*d*. The paving, we should mention, ought to be as level as possible, consistent with the fall for drainage, or the horse will be injured from the strain on the tendons of the hind legs. Brick paving is preferable for the space behind the stalls.





If there is a double row of stalls opposite one another, the space between in the middle should not be less than eight or ten feet, but, from the irregularities of temperature, those stables are the most healthy which do not contain more than six or eight horses. From $5\frac{1}{2}$ to 6 feet should be allowed for the width of stalls, and the sides should be lined with planed wood. 16 feet is a minimum width for a stable, allowing 7 or 8 feet for the horse. The gratings at the back and between stalls, should be about a foot square, with cesspools 2 feet deep, lined with cement, and communicating with the liquid manure tank. The

door, if it can be avoided, ought not to be opposite a stall; it may be 4, $4^1/_2$, or 5 feet wide, and 7 or 8 feet high. Speaking of farm-horse stables, Mr. Andrews says; — "12 feet in height, and 16 feet in width are the minimum dimensions. This 16 feet width should be appropriated in the following manner; — 2 ft. for the manger, 7 ft. for length of stall, 1 ft. for the drain, 4 ft. for a clear gangway behind the horses, to facilitate the removal of manure, and the other business of the stable, and 2 ft. for the projection of the harness, etc., hanging on the tacks behind each horse. Separate stalls should be provided for each animal by a partition called a *travis.* On no account should a swinging bar be used, bad accidents often occuring from this ill-advised economy. The travis should be five feet high at the tail post, and rise to seven at the head. The posts for supporting it should be of oak or cast iron, securely fixed into the ground, and, if the construction of the stable admits of it, also to the joists of the floor overhead. The top of the travis, called the *ramp rail,* should also be made of oak, tenoned into the tail post at one end, and the bond timber of the wall at the other. On the underside is a groove in which the upper end of the stall boarding is placed, the lower ends being secured in the same manner, with a corresponding piece of timber, or, what is better, stone, which is grooved in the same manner as the ramp rail. The rack and manger are variously placed; the usual plan is a wooden or stone trough, extending the whole length of the stable, and the rack in the same manner above — the hay being dropped from the loft over-head into it; but this plan is liable to a variety of objections. The rack being placed over head, the horse will draw and let fall among the litter as much as he eats. Blindness in horses is also frequently caused by the hay-seeds falling into their eyes when eating from high racks; nor can the defence of its producing high carriage apply in the case of work-horses, as they are not required to hold up their heads like carriage and other horses; and, generally, on returning to the stable, are so tired, that it is unnecessary cruelty to force them to feed in this way. The most approved plan is to place the rack low down in one angle, and the manger in the other, which allows of the horse eating while lying down. The manger is often made the whole width of the stall, sloping inwards towards the ground, to be out of the way of the horses' forelegs." The old fashioned wood mangers are by far too large, and the best are of iron, about a foot in length and breadth, and nine inches in depth. The horse may be severely injured by the wood mangers splintering.

A manger for water is excellent, so that the horse may drink at pleasure. An idea is prevalent that horses should only have water given to them at certain times, but nature is a better judge than man, and tells the animal rather than him, when it requires drink; for it is doubtful whether any horse will drink unless it is necessary: it certainly never gets drunk, and is thus evidently, in this respect, a little more sensible than mankind. A waste pipe is desirable, and the water should be laid on from the cistern above. Hay racks are preferable at the level of the manger. The best are of iron with the bars rounded, about two inches apart. A size to hold from half to a whole stone of hay will suffice. If placed on high they are convex, bulging out from the wall. Hay lofts over stables are objected to by many. Lawrence observes; — "According to the good old and present custom, they are the receptacles of all kinds of impurities, as well as hay, the excrement of cats and mice and exuviæ of spiders, and the accumulated and sacred dusts of perhaps half a century. Add to these trifles the perpetually ascending clouds of steam from the stabling below, contaminating, drying and exhausting the hay of its fragrance and of every pure and beneficial quality. Hay should remain in the stack, in order to have its utmost fragrance and moisture of quality, to be cut often, and taken fresh to the horses, there being a clean and cool hay room near the stable to contain small quantities. The gangway and walls of the stable should be perfectly clear of all encumbrance of chests, pails, brooms, shelves, saddles, or lumber of any kind, for which extra rooms are the proper place." Mangers, racks, and water-troughs are now manufactured of iron, in continuous divisions, and can be fixed to the sides of the stalls with no posts or front bearers. The prices vary according

to description, and they are plain, galvanized and enamelled. They may be had from £ 2 „ 15 „ 0 to £ 4. Fittings complete of a similar description for loose boxes range from £ 2 „ 10 „ 0 to £ 3 „ 18 „ 0. Halter guides and collar reins are attached to a ring in the manger, not tied, but dropping down with a plummet at the end, leaving the animal full liberty to lie down; a shorter halter may be used in the day time to prevent backing into the passage behind. Harness and saddle brackets and pins should be provided in the harness room, together with shelves and closets, or recesses for brushes, combs, etc.

There should be proper receptacles for straw and hay. Keep in one chest with divisions, or in separate chests, the peas, beans, oats, bran, etc. The corn chest should be provided with lock and key and not be kept in the stable. If the coach house is not paved, there should be wheel boards 9 inches wide for the wheels to rest on. Cart horse stable doors are often made in two halves, so as to be enabled to look in by opening the one above. The lower door is bolted, and a lock and thumb latch provided to the upper one. Iron and wood sashes are used to the windows; skylights are advantageous, as they can be opened to aid ventilation. It is an erroneous and very general notion that a stable should not be well lighted. "A horse," says Mr. Stewart, "was never known to thrive better for being kept in a dark stable. The dealer may hide the horse in darkness, and perhaps he may believe that they fatten sooner there than in the light of day. When a horse is brought from a dark stable to the open air, he sees very indistinctly, he stares about him, and carries his head high, and he steps high. Dark stables may thus suit the purposes of dealers, but they are certainly not the most suitable for horses. They are said to injure the eyes. There is not perhaps an animal so liable to blindness as the horse. It cannot be said that darkness is the cause, but it is well known that the eyes suffer most frequently where there is no light. Whether a dark stable be pernicious to the eyes or not, it is always a bad stable. It has too many invisible corners about it ever to be thoroughly cleaned. All these things considered, it is evident that the stable ought to be well lighted." It ought also to be well ventilated, this indeed being a point of very considerable importance. In our article on Ventilation, the general principles and their application are fully stated, and we need add but little here. The cleaner the stable is kept, the better will it be ventilated. It should be swept and cleaned out every morning, and not a particle of refuse left unremoved to the dung pit. Ammonia, as we once before remarked, rising from decaying matter, destroys the walls of a building, by its conversion into nitric acid, dissolving the lime of mortar. The injury thus caused by the formation of soluble nitrates is called in Germany *Salpeterfrass.* If sulphate of lime, in other words gypsum, is spread lightly over the floors of stables, the ammonia is fixed, loses its smell, but is, at the same time, just as valuable as a manure. Leading a tube from the ceiling of a stable into a flue is a good mode of ventilation. Sometimes a channel is constructed over the centre of each stall about 18 inches wide and 9 inches deep, communicating with the flue and having a flap to open or shut at pleasure. The introduction of air bricks is cheap. If there are eight horses, construct a regular ventilator on roof, with louvre boards and perforated zinc at the bottom, and pulley and cord to regulate opening. About 2 air bricks for entrance and exit of air to each horse will suffice. Mr. Shepherd justly remarks that; — "It is distressing to the feelings to inhale the air in some farm stables at night; particularly in old steadings, economically fitted up. It is not only warm from confinement, moist from evaporation of perspiration, and stifling from sudorific odours, but cutting to the breath and pungent to the eyes, from the decompostion of dung and urine by the heat. The windows are seldom opened, and many can scarcely be opened from disuse; the roof in fact is suspended, like an extinguisher, over the half stifled horses. But the evil is still farther aggravated by a hay loft, the floor of which is extended over and within a foot or less of the horses heads. Besides the horses being thus inconvenienced by the hay loft, the hay in it, through this nightly wasting and fumigation, soon becomes brittle and contracts a disagreeable odour." There is a smell resembling hartshorn

which arises from part of the decomposing matter containing it in large quantity; and it is not wonderful that distemper, farcy and glanders should attack horses confined in such places. The fittings of the design given are plain and economical, and the cost will average £ 250.

DESCRIPTION OF PLATES.

Plates 50. to 60.

Plate 50, contains details of desk and seats connected, the latter without backs, but another detail of disconnected seats with backs is given below; they are adapted to schools and also other purposes; and the mode of workmanship is sufficiently indicated from the size of the scale.

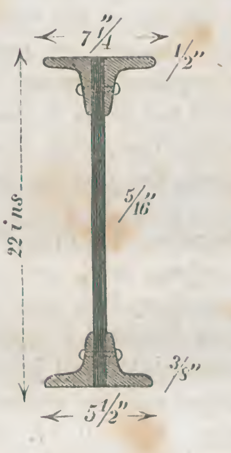
Plate 51, is a design for the elevation of a Warehouse or Factory. The windows are connected so as to give the idea of *one* open space within, which is often required, instead of numerous separate apartments; and it is because of its simplicity that we have not given a plan, as well as from the varying requirements. Stone facing is proposed for the front, and slate slabs or Italian formed zinc to the roof. It is obviously unnecessary to give the cost in this instance.

Plates 52. 53. contain Illustrations of Iron Construction, Fireproof and otherwise. On Plate 52, Figs. 1, and 2, show Fireproof Construction with wrought and cast iron girders, brick arches, boarded floors and lathed ceiling. In Fig. 3, a large cast iron girder is substituted for that of wrought iron in the former example. Fig. 4, has cast iron girders carrying binders of wood, the floor not being fireproof. Figs. 5, and 6, indicate methods of connecting plates and joists with iron girders. On Plate 53, Figs. 7, and 8, show sections of iron columns and the method of connecting girders with them. Figs. 9, are details of columns for balconies. Figs. 10. 11. 12, are various forms of shoes. Figs. 13. 14, are continuous sections of construction, fireproof and otherwise, in which iron girders are introduced. We shall add a few remarks on fireproof construction, but our space is now so limited, that we can only give a fragment of what we intended to lay before our readers. In case of fire, iron columns become so heated that they first crumble and then melt rapidly, or they are split by the water from the engines; and good solid timber posts can be more reckoned on for their time of duration, greater confidence being thus felt on entering a burning edifice, iron columns giving way suddenly, the water accelerating their destruction as well as that of stone columns, but doing good to those of wood: brick piers are most preferable. Again, where arches are turned from girder to girder, if one of the latter is fractured, or an arch settles, the building will often fall, from each arch being greatly dependant on the reaction of the adjoining ones for support. Wood floors are also objectionable, from the facility fire has in travelling between them, and the draught of air allowed.

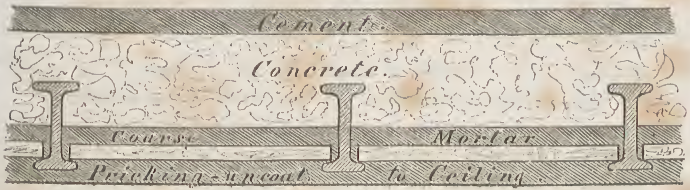
The system of fireproof construction now being, by the Emperor's wish, extensively adopted at Paris, "consists of I shaped iron girders, from 6 to 8 inches deep and 2 feet apart, kept together by saddle bars. Boards are placed between the girders, and the space is filled in with pieces of stone and the excellent plaster of Paris. This concrete sets in a very few hours, and the boards are removed, the mortar being sufficiently tenacious to hold the mass together. There are long diagonal tie bars at the angles of the walls to keep the whole construction compactly together."

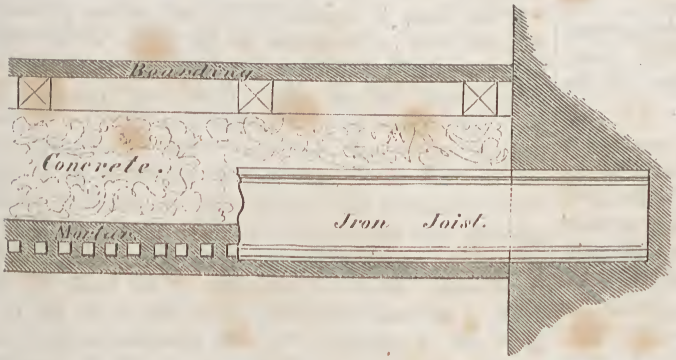
The following rule for calculating the dimensions of I shaped cast iron girders will be found useful. The weight on one superficial foot of flooring being found, multiply it by the number

of superficial feet, thus ascertaining the whole weight resting on the girder; one half this, or half the weight distributed, gives the weight bearing on the centre of the girder. *Rule.* Multiply the weight on the centre by the length of the girder, and divide the product by 675 (the constant number) multiplied by the width of the bottom flange, the square root of which gives the whole depth of the girder; multiply this last by .7 for the depth of the middle part; and for the breadth of the middle part, multiply the width of the bottom flange by .4. Set down the weight of timber flooring at 40 lbs, and the loading at 120 lbs per foot super; the brickwork may be taken at 100 lbs per cubic foot. For floors not fireproof, take from 180 to 200 lbs for the weight of timber, flooring, plastering, etc., per foot super. To ascertain the weight of a cast iron girder, find the number of superficial feet and set them down at their respective thicknesses; reduce them to inch thicknesses, and multiply the total by 40 lbs (the weight of one foot super of inch iron) which will give the whole weight. Cast iron girders are usually connected with $^3/_4$ inch bolts, passing through ferrules or sockets. The subject of wrought iron girders is not so well understood as that of cast iron. Mr. Fairbairn, one of the highest authorities, prefers the *plate* beam, represented in the margin, to the box beam, as, although inferior in strength, it is simpler in construction, less expensive, more durable, resists better atmospheric changes, and admits of easy access. Beams with cellular tops present also many advantages. The superiority of wrought to cast iron in case of fire cannot admit of doubt; and we shall take the liberty of giving a few of Mr. Fairbairn's remarks on their relative strength and cost. Speaking of bearings of 30 feet, and of wrought iron plate beams of the above section, he remarks that they "may be composed of plates 22 inches deep $^5/_{16}$" thick, rivetted on both sides, as shown in the section. The breaking weight of this beam, taking the constant at 75, would be as follows; — Let W represent the breaking weight in tons, a the area of the bottom flange, d the depth of the beam = 22 inches, and l the distance between the supports = 360 inches, then we have $W = \frac{a.\ d.\ c.}{l} = \frac{75 \times 6 \times 22}{360} = 27.5$ tons in the middle, or 55 tons distributed equally over the surface, Now a cast iron beam of the best form and strongest section, and calculated to support the same load, would weigh about 2 tons, whereas the wrought iron beam would only weigh 16 cwt. 1 qr. 14 lbs, or little more than one-third of the weight of the cast iron beam. This difference of weight is of considerable importance, as the advantages of using the plate beams do not consist solely in the saving of nearly two-thirds of the material, but there is less weight to carry, and much greater certainty as regards the ultimate strength and security of the beams. Assuming that cast iron beams can be delivered at the foundry at £ 6 „ 10 per ton, and that the wrought iron plate girders can be manufactured at £ 16 per ton, it follows that a cast iron beam 40 cwt. at 6*s* 6*d* = £ 13; a wrought iron beam 16 cwt. 1 qr. 14 lbs at 16*s* = £ 13 „ 2, making a difference of only two shillings between the cost of the one and the cost of the other. Assuming, therefore, the prices to be the same, we have, in the case of wrought iron beams, only about one-third of the weight of metal to carry; and moreover, the superior lightness of the wrought iron will enable us to erect and fix them in their places at considerably less cost." He further expresses his conviction that wrought iron beams can be manufactured at £ 14 per ton. Assuming the depth of the girder at a convenient dimension, to find the area of the bottom flange, the length of the girder is to be multiplied by the breaking weight in tons, and this product, divided by the depth in inches of the girder, multiplied by the constant number mentioned.



We have yet to mention the most effective system of fireproof construction, that known under the name of "Fox and Barrett's Patent," acknowledged by Mr. Braidwood, probably the safest





authority, "as being practically the best within his knowledge." The diagrams in the margin indicate the simplest form, the first figure showing a cement, and the second a boarded surface. The floor is formed by laying rough strips of wood (small clay draining pipes may be substituted, and these are preferable, as giving a key, if of a triangular form) between the wrought iron rolled joists, about 1′ „ 9″ apart, and bearing on the bottom flanges. A layer of coarse mortar is laid on the strips, and pressed down between them, to form a rough surface for the pricking up coat of the ceiling, which subsequently quite imbeds the strips. A layer of concrete is then applied. The thickness of this depends on the bearing and the requisite strength, and it may be applied in two layers to facilitate drying; the ceiling must be of such a thickness as to perfectly imbed and protect from fire, the strips of wood as well the iron joists. The firmness, strength and rigidity of floors thus formed is surprising; the ignition of the slips is impossible; the current of air in other floors is obviated; together with the still more objectionable pressure and reaction of brick arches, never *resting.* The weight of the floor is inconsiderable, about 10 to 12 cwts per foot run of the walls; the expansion of the iron will rarely exceed .03 in a length of 20 feet; and the economy of the system is undoubted. The joists, of wrought iron, are rolled into a strong, light and economical form, and tested to bear weights of from 120 to 150 lbs per square foot, the test being, in the case of cast iron, $^1/_3$rd of the breaking weight, and for wrought or rolled iron, within the elastic limit of the metal; but the strength and test are increased to meet all requirements. Rooms 24 feet in width have been constructed with single joists; but in spans much exceeding 20 feet, it will be advisable to have wrought iron girders, and in spans of 60 feet to have columns 20 feet apart. The thickness of the floor rarely exceeds 12 inches; and the system has been extensively adopted all over the kingdom: at Guy's Hospital the reader may observe its practical success.

Plate 54, contains details of iron rails for Staircases. Figs. 1, are iron sashes and frames suitable for Warehouses, Conservatories, etc. Figs. 2, and 3, sufficiently explain themselves.

Plates 55. 56, contain plans and details of two Ceilings.

Plate 57, includes a variety of designs for Clock and Bell Turrets, which may be executed to various scales.

Plates 58. 59. 60, present a series of Headstones, Altar Tombs, and Mural Monuments, of Gothic and Classic character, for Cemetery Chapels and Grounds.

THE VALUATION OF HOUSES AND ESTATES.

Having treated in a previous article of the measurement and valuation of artificers' work we have now to consider the mode of fixing the value of land and houses, whether freehold or leasehold, and this is properly ascertained by proceeding on scientific and definite methods, certain tables being used to save time and facilitate calculation.

The first preliminary is to ascertain the clear annual value of the property, after deducting all outlays; taxes, encumbrances, and outgoings generally falling on the landlord.

The use of the tables is to find the value, or number of years purchase, which any property is worth at the rate of interest required, for a perpetuity, a definite time, or for a period depending on the life of one or more individuals, according as the property is to be held. The interest in the tables is compound, being a return of the principal as well as the interest on it; — that is, in valuing a property, it is considered worth so many years purchase, as will return the money given for it in the time, and also interest equal to what can be obtained by investing the capital elsewhere; to do this it must be at least one per cent above the ordinary interest.

The present system of calculation is of comparatively modern date. In 1802 some tables for the purchasing and renewing of leases were published by Francis Baily of the Stock Exchange, and many of the authors, who have since written on the subject have derived from this work great assistance, which, indeed, has often not been at all acknowledged. We shall avail ourselves of some of Baily's lucid explanations; for he gives a very clear statement of his subject, and states in his preface that, when his work was written, the only publication in use was a little book entitled "Tables for the Renewing and Purchasing of the Leases of Cathedral Churches and Colleges," first published about 1685. The work was anonymous, but had on the title page a recommendatory Latin note by Sir Isaac Newton. After the death of this great man the publisher artfully prefixed to the book, in large letters, "Sir Isaac Newton's Tables," under which name it has since gone. It was long out of print when Baily published his tables; and he was the first to apply to them decimal fractions, then but little used, to facilitate calculations.

We shall consider in the following article, first, Freehold property and then Leaseholds for terms certain, giving the simple rules for ascertaining the value of each description, and then treat, under their proper headings, on Reversions of Freeholds and Leaseholds after certain terms, Renewals of Leaseholds for certain terms, Purchase of Leaseholds for Lives, Reversions of Freeholds, or Leaseholds after Lives, and Renewals of Leases for Lives, concluding with some useful Memoranda.

"A lease is, properly, a conveyance of any lands or tenements, usually in consideration of rent, or other annual recompense, made for life, for years, or at will." The two first items only have here to be considered.

In granting a lease for a term of years the *Lessor* generally demands of the *Lessee* payment of an annual sum equal to the rack rent of the estate, to continue during the term; and the value of the estate is determined by the rent it will produce.

If the lease is disposed of for one present payment, this sum will be contingent on the length of the term and the interest which the purchaser can make of his money during the said term. If the rate of interest is low, the sum to be paid for the lease will be proportionately high, and *vice versa.* "The money given for the purchase of a lease may be considered as a sum, which, put out to interest, will enable the lessor, by taking annually from the principal, to repay himself the annual rent of the estate during the given term; therefore, no more money should be demanded by the lessor for the grant of the lease, than will enable him to do this at a given rate of interest." We have therefore to settle the present value of the grant of a lease, in lieu of spreading the money over the term of years proposed in the shape of rent. The rack rent of an estate is to be treated in the light of an annuity, as precisely the same system is adopted in determining the value of one as of the other. Consider the lessee as the lender of the money paid for the loan of the property, and the lessor as the borrower of the cash paid down at once for the annual rents, otherwise spread over the term. Thus, if the landlord, or *borrower,* allows the tenant, or *lender,* to make 9 per cent interest of his money, the landlord borrows the sum at the same high rate. The sum paid by the lessee to the lessor may be considered as money advanced, which enables the latter, by putting it out to interest at the rate determined upon, to get back the rent of the property during the term; and we have therefore to ascertain the sum, which, invested at the proposed rate, will do this. Such a sum in short must be received yearly, equal to the interest the capital will elsewhere command, and the overplus return the principal in the course of the term, or a sum which will meet the fine for a renewal of the lease. The author of "An Answer to A Pamphlet entitled Sir Isaac Newton's Tables," published in 1731, thus explains this matter of lending. "I know it has been a common notion, that the letting leases is selling the estates for a time, and the purchasers, or lessees do commonly consider the taking these leases as purchases, by which they are often led into mistaken notions of the nature of their estates, and of their right and interest in them, and, consequently, in their computation of their true values. The selling of an estate must, in common understanding, signify the transfering to the purchaser an absolute property in the estate, sold either in fee simple, or for some limited time; for if the estate sold is not to remain an absolute property in the purchaser, but is laid

under any restraints, conditions, or reservations, it will not come under the denomination of a sale, but must be either in the nature of a lease or a mortgage." It is essential clearly to comprehend that the system is simply one of lending a sum for a given time. If one man lends another £ 500 at 5 per cent, on say the security of another man, he has his interest and (if he can get it) the principal returned at the end of the period for which it was lent. The acquisition of leaseholds is similarly considered, with the advantage that there is *possession* of the property, while, in the former case, the money lent may never be returned. In the latter there is a substantial, material, tangible bond, in fact the money advanced is virtually retained; for although, in the case of a leasehold, the sum lent upon it is never returned, it can be made out of the property, *together* with the interest, if the value of the purchase is properly calculated: — that is, if, as the rents come in, the owner puts the money out to interest at the same rate at which the valuation was based. The number of years purchase is regulated, not only by the interest which may be made on money, but also by the *time* a property may be safely calculated upon not to be affected by extraneous circumstances in its ability to make the return. So it may be said, that in the public funds consols are at 90, 95, etc., according to the number of years people will risk their money on the durability of public credit. At the rate determined on, *transfers* are made of stock from one individual to another, which presents the same advantage as if the government returned on demand the moneys lent.

The first table at the end of this article facilitates the calculation of the sum to be given for leases, etc., supposing a certain rate of interest and term of years. The yearly *net* rent, or annuity, being supposed to be one pound, the figures under the rates per cent denote the number of years purchase to be given for the property, according to the interest proposed, and the years for which it is to be held, as in the first column. The clear yearly rent, or annuity, being multiplied by the value of one pound, at the rate of interest at the top and according to the time at the side of the table, gives the present sum to be paid as the fair value under the proposed circumstances.

It must be obvious that the value of an estate, depending not only on the term for which it is held and the rate of interest proposed on the investment, but also chiefly on the net rental available after all deductions from the rack rent, it is of the utmost importance to ascertain what is the clear, surplus, annual rental before applying the table given, want of accuracy in this respect quite falsifying the expectations that may be formed. The taxes and general rental in the neighbourhood are easily ascertained, but, of course, the value of a property is dependant on contingent and varying circumstances, and two houses, costing the same sum to erect, will wonderfully differ in value according to the fluctuations that may occur in the locality in which each is placed. All this must be kept in view by the shrewd valuator of property; and although there is much that he cannot possibly foresee, there are always many circumstances tending to affect more or less the future value of property which should not escape his consideration. On this, however, we do not propose now to enter, but merely give the rules for ascertaining the value of leases, etc. when the rack and net rent for the term is ascertained and the rate of interest determined. Some usual deductions may however be mentioned. Reduce the rent always to a clear annuity, deducting a sum for insurance, chief or quit-rent and fee-farm being also allowed. Deduct generally such taxes as fall on the landlord, including any in arrear which cannot be obtained from the last tenant, and which of course the future one cannot be expected to pay, only being called upon to discharge tenant's rates and taxes; but although Queen's taxes may be, parochial and local rates and taxes in arrear cannot be recovered from a new person coming into possession. The property tax is not to be deducted, as the owner will have to pay this, or income tax, on any description of property, whether real or personal; but all deductions are to be made of sums which the owner of an absolute annuity is free from, the object being to reduce the rent to such clear annuity. The ground rent is to be deducted, and the land tax is fixed by law on the landlord, although often paid by the tenant and the receipt tendered as so much towards the rent: on the subject of taxes, however, we shall speak more at length in another article. Fixtures are usually valued; and the sum to be expended on repairs or alterations must be fixed, as well as the requisite annual cost, during and at the end of term, of requisite repairs, painting, etc., which no one but a practical surveyor or builder can accurately estimate: *substantial* repairs often fall on the landlord in the case of a lease, but the document must be carefully perused. Contingencies, arising from loss of tenants, etc., are to be set down; and there is often much dispute about the correct fixing of these matters, the object of the lessor's surveyor being to raise the value of the property as high as he can, while the lessee's representative seeks to diminish it, much art and sharp practice continually occurring. Reserved rents and fines considerably modify the aspect of an investment; and the general deduction by the author of "Church and College Leases" of 30 per cent for taxes, repairs, etc., is vague and usually too much. Coming to the same amount of deduction, another author has calculated it as follows; —

Land Tax	£ 10	per cent.
Repairs	10	„
Casualties, etc. . .	10	„
	£ 30	„

The surveyor for the lessee will be generally safe in allowing for these particulars; — Ground Rent, Reserved Rent (if any), Fine (if any), Land Tax, Taxes in arrear and such Rates and Taxes as fall on the Landlord, Insurance, Collecting, Legal and other expenses of Transfer, and every expense incured previous to possession, Value of Fixtures, Repairs and Alterations, Annual Repairs, Dilapidations at end of term, Contingencies arising from loss of tenants, Deterioration in the value of the property, etc.

VALUATION OF FREEHOLDS.

We shall now proceed to give the ordinary forms of calculation, taking first the *Purchase of Freeholds.* In cases of mixed freehold property, consisting of land and buildings, the valuation should be divided into two parts; first, that of the land, which is indestructible, and second that of the building, which will decay and become useless. Although the value of land, particularly that appropriated for building purposes, fluctuates considerably, the valuator has mainly to do with its *present* value; and, if there is a building, the time this may fairly be calculated upon to endure and return the rent must be taken into consideration, which can only be estimated by a surveyor or builder. Instancing the case of a property, consisting of house and land producing a clear rental of £ 30 per annum, we arrive at the purchase value of the fee-simple in this manner. Take the house and consider the cost of erection and 7 per cent, or about 14 years purchase, as the proper rate of interest, since casualties in letting, loss of tenants, etc., may occur to diminish the interest of the capital invested. Supposing £ 1500 is the sum determined upon, the building rent of the house at the rate of 7 per cent will be £ 105, which, deducted from the full rent of £ 130, leaves £ 25 as the rent of the land, or ground rent. 4 Per cent, or 25 years purchase, is an usual price for the latter, which gives the value of it (£ 25 per annum) at £ 625 for the fee-simple. The house, however, may only bring in the contemplated rent for 40 years, which at 7 per cent by the first table, may be taken at $13^1/_2$ years purchase, equalling (rent £ 105) £ 1417. Add to this the value of the ground, £ 1417 + £ 625 = £ 2042, as the present value of the property, without allowing for the old materials, which are to be valued and the present amount due for them settled, discounting at 5 per cent. It will have been perceived that, for the sake of brevity and simplicity, the rent has been taken without deductions, on which latter subject we have already sufficiently remarked. Of course the rate of interest is dependant on the market value of money. When owners are compelled to part with their property on account of public works, 20 years purchase, or the 5 per cent rate of the table, is generally adopted in valuing houses, but this is really too little interest for the buyer on the perishable part.

The following are the simple rules in use for the purchase of freehold property, reversions, etc., being hereafter considered. The first table is used; and in the last line is the number of years purchase which a freehold is worth according to the proposed rate of interest. It will be scarcely necessary to refer at all to the table; for if we divide 100 by the rate of interest desired, the quotient is the number of years purchase: thus dividing 100 by 5 per cent, as the rate of interest, gives 20 years purchase.

To find the gross sum to be paid for a Freehold, — Multiply the *clear* annual rent, after making all proper deductions, by the number of years purchase according to the desired rate of interest.

£ 60 Rent.
20 Years Purchase, or 5 Per Cent.
£ 1200 Value.

Or, multiply the annual rent by 100, and divide the produce by the proposed rate of interest.

£ 60 Rent.
100
Rate of Interest 5) 6000
1200 Value.

The first is the most rapid process when the number of years purchase is an even quantity, and the latter when it is fractional, or not precisely known. The figures in the table give, of course, the number of years purchase, or value of £ 1, and we have consequently only to multiply as at first by the number of pounds annual value.

To find the clear Annual Rent to be charged on a Freehold in order to return a certain rate of Interest, multiply the total sum expended by the desired rate of interest, and divide the product by 100.

£ 1200 Sum exped.
5 Per Cent Interest.
100) 6000
£ 60 Rent.

To find the Rate of Interest resulting from a given rent for a sum paid, multiply the clear rental by 100 and divide the product by the sum paid.

£ 60 Rent.
100
Sum Paid 1200) 6000
5 Per Cent.

These simple rules have long been clearly understood. We are, however, unable to trace the statement of them further back than 1685, in the reign of James II., when the author of "Church and College leases" observed; — "Divide 100 by the purchase of the fee-simple, the quotient shows the rate of interest; as, if the fee-simple be 20 years purchase, then 100 divided by 20 the quotient is £ 5, for the rate of interest. Or, if you divide 100 by the rate of interest which you desire to have in buying anything, the quotient shows how many years purchase you may give for it; thus, if you desire to have 8 per cent profit, then divide 100 by 8, the quotient is $12^1/_2$, that is twelve years and a half's purchase; and so many years purchase may you give, and make 8 per cent profit."

VALUATION OF LEASES FOR CERTAIN TERMS.

In valuing leases we have nothing to do with the land, only so far as deducting the ground rent to be paid in seeking the clear annual value.

Before giving the rules applicable to leaseholds, we should remark that the values in the table are calculated on the presumption that the rents are paid yearly; of course if the money comes in half-yearly or quarterly and is put immediately out at interest, the gain is proportionately higher. "The value of a lease, the rent of which

is payable half-yearly, is equal to half the value of the same lease payable yearly, calculated at half the given rate of interest, and to continue double the number of years; and the value of a lease, the rent of which is payable quarterly, is equal to one quarter the value of the same lease payable yearly, calculated at one quarter the given rate of interest, and to continue four times the number of years. As the present value of an annuity (or lease) has been defined to be such a sum as, put out to interest at a given rate required, will provide for the several payments of the annuity as they became due, consequently the more frequent the payment of interest on such sum, the less will be the present value of the given annuity; because a smaller sum, put out to interest in this way, will, *cæteris paribus*, as effectually provide for the several payments of the annuity as a corresponding larger sum, where the payment of interest is not so frequent: and, on the contrary, the less frequent the payment of interest on such sum, the *greater* will be, *cæteris paribus*, the present value of the given annuity."

The first table shows the number of years purchase to be given for the grant of a lease for any number of years up to 100. At the top of the respective columns are the several rates of interest that may be proposed, and in the first side column the term for which the lease is to continue.

To find the sum to be given for a Lease of a given term in order to make a proposed interest on the investment. Term supposed 21 years, *clear* annual rent £ 50, and 7 per cent interest required. Look to the table under the rate of interest, and against the number of years the lease is to run for the number of years purchase it is thus worth, multiplying the clear annual rent by it.

£ 50 Net Rent after deductions.
$10\frac{3}{4}$ Years Purchase at 7 Per Cent for 21 years.
500
37
£ 537 Present Value.

The deductions can be made as so much per cent off the present value, or set down accurately and made from the annual rent before applying the rule. The correctness of the rule is evident: as the values in the tables denote the sum to be given for one pound per annum, so multiplying by the number of pounds rent gives the present value of a lease, annuity, etc.

Taking another example, suppose a lease is to be valued for 30 years and the net rent is £ 50 per annum, out of which the tenant has to pay a rent charge of £ 20 for 15 years, what sum may be paid to clear 7 per cent, there being no other deductions, these having been already allowed.

£ 50 Rent.
$12\frac{1}{2}$ Years Purchase for 30 years, at 7 Per Cent.
600
25
625
180 Deduction.
£ 445 Present Value.

£ 20 Rent charged.
9 Years Purchase for 15 years, at 7 Per Cent.
£ 180

In a similar manner we can ascertain the value in one present payment, or gross sum, of ground rents, quit rents and annuities, with which leases are often encumbered, and which are often sold separately, ground rents and annuities being continually disposed of for terms of years. In the case of a lease charged as above, the present value is first ascertained and the deduction made from it.

To find the clear Annual Rental corresponding to the sum paid down for a Lease, divide the total sum (adding all expenses) paid for the lease by the number of years purchase found in the table against the given term under the proposed rate of interest; the quotient is the rent. Supposing £ 500 has been given for a 60 years lease, what is the equivalent annual rent to allow the purchaser 7 per cent.

Sum Paid.		Years Purchase, 60 years at 7 Per Cent.		Rent.
£ 500	divided by . .	14	. . equals	£ 35 „ 14.

It is thus evident that the £ 500 given for the lease would produce an annual income of £ 35 „ 14. for 60 years, at 7 per cent, and the person who advances the money for the lease may be considered as paying an annual rent of £ 35 „ 14.

To ascertain the number of years Purchase in any sum paid for a lease, divide the sum paid by the clear annual rent, the quotient being the number of years purchase.

Rent £ 100) £ 1000 sum paid
10 Years Purchase.

The rate of interest allowed the purchaser and the term of the lease are immaterial in applying this rule, as the result is not touched by them.

To find the Rate of Interest allowed, look at the table against the term of years for which the lease is to run, and see if one of the values corresponds nearly to the number of years purchase, ascertained by the preceding rule, which will be the rate of interest allowed the purchaser. Thus £ 600 being given for a lease of 21 years of a clear rental of £ 50, by the rule before mentioned 12 is found to be the number of years purchase, and looking in the table against 21 years we find the interest to be between 5 and 6 per cent, the nearest value being 11. 76 under the 6 per cent column. Baily gives the following rule as approximating more exactly to the true rate of interest. Divide the *difference* between the number of years purchase, as ascertained by the last rule but one, and the next highest value found against the given term in the table, by the *difference* between the next highest and the next lowest value found against the same term; and the quotient thence arising, being added to the rate of interest marked over the highest value thus found, will give nearly the rate of interest required, if there is *one* per cent difference between the two columns; but if there is only *half* per cent difference between them, then *half* the quotient being added will give nearly the rate required.

We have now stated the more simple rules relating to the valuation of Freeholds and Leaseholds and those which are most generally required, but, before proceeding to glance at other aspects of the subject, we may be permitted to draw the reader's attention to a matter which

cannot be explained clearer than in the language of the author whom we last quoted. He refers to the first table given. "In looking over this table no doubt many have been struck by the little difference which seems to exist, particularly in the higher rates of interest, between the value of lòng and short leases: thus in the column marked 10 per cent, the value of a lease for 24 years is 89.8 years purchase; and the value of a lease for 68 years is 9.98 years purchase; so that there is a difference of one years purchase only in these two leases, the one of which is to last 44 years longer than the other, or nearly three times the length. Again, the value of a lease for 100 years is 9.99 years purchase, so that it requires only one thousandth part of a year's purchase to make this lease equal to a perpetuity, to which the period of one hundred years bears no more proportion than the millionth part of a drop of water to a million times the whole ocean. But we should recollect that the purchase money paid for a lease is a sum only *lent* for the given term; for that the *surplus* annual *income*, or *interest*, over and above that which is expressed by the table, being put out to interest, would, at the end of the term, amount to the whole purchase money paid for the lease; which money might be laid out in another similar lease, and, after that, in another, and so on continually, making the whole equal to a perpetuity. It must be obvious to everyone, that the shorter the lease is, the greater ought to be the surplus income laid by for the redemption of the purchase money; and, on the contrary, the longer the lease, the less ought to be such surplus income which is laid by, for the *greater* sum will amount to the same at the end of the *shorter* period, as a corresponding *less* sum, at the end of the *longer* period. The little difference which exists between the value of long and short leases is founded on reason and truth, and, according to the principles on which the table is calculated, the sum which is given for a lease may be considered as the value of the perpetuity of that rate of interest denoted in the table; and that all money laid out in this way is money advanced and *lent* only, not money annihilated and sunk."

REVERSIONS OF FREEHOLDS AND LEASES AFTER CERTAIN TERMS.

The possession of Freehold and Leasehold estates is often not entered upon until the expiry of a term of years, or the death of one or more persons; the former we have now to consider. The same rules will apply to both Freeholds and Leaseholds. Deduct the value of the short lease from that of the long lease, or, in the case of a freehold, from the perpetuity, and the difference is the value of the long lease, or the freehold, as the case may be. We may proceed in two ways, either taking the *money values*, or the values in *years purchase* and ascertaining the difference.

Suppose the case of a freehold bringing in a clear sum of £ 150 per annum, what is the value of the reversion after 30 years, 6 per cent being the rate of interest proposed.

£ 150 Rent.	£ 150 Rent.
$13^{3}/_{4}$ Years Purchase for 30 years at 6 p. c.	$16^{3}/_{4}$ Years Purchase for Freehold at 6 p. c.
450	900
150	150
112 „ 10	112 „ 10
£ 2062 „ 10 Present Value of Lease.	2512 „ 10
	2062 „ 10 Deduction.
	450 „ 0 Present Value of Reversion.

Or the valuation may be put as follows; —

Purchase of Freehold at 6 per cent —	$16^{3}/_{4}$ Years Purchase.
Do. Leasehold do.	$13^{3}/_{4}$ do.
	3

£ 150 Rent.
3
£ 450 Value of Reversion.

Take another example of a lease for 70 years worth £ 100 per annum, but underlet for 30 years at £ 85 rental, the whole term of 70 years being in the market. Supposing 7 per cent to be the interest which the purchaser desires to make, what sum may be advanced.

£ 15 Difference in Rent for 30 years.	£ 100 Full Rental for 70 years.
$12^{1}/_{2}$ Year Purchase at 7 Per Cent.	14 Years Purchase at 7 p. c.
180	400
7 „ 10	100
£ 187 „ 10 Value of Difference.	1400
	187 „ 10 Deduction.
	1212 „ 10 Present Value.

The next example in which we give the briefest mode of calculation is more strictly a question of reversion than the last. Value the reversion of a lease for 40 years after the next ten years; rent £ 50, rate of interest 10 per cent.

40 years at 8 p. c. 11 Years Purchase.	£ 50 Rent.
10 „ „ $6^{3}/_{4}$ „	$4^{1}/_{4}$ Years Purchase.
$4^{1}/_{4}$	200
	12 „ 10
	£ 212 „ 10 Present Value of Reversion.

That is £ 212 „ 10 is the sum which, put out to interest at the rate of 8 per cent, will provide for the due payment of £ 50 per annum for the rest of the term of 40 years *after* the ten first years, or, in other words, for 30 years after the next 10, meeting thus the interest of the lessor if he can afford to allow the lessee the high rate of interest.

RENEWALS OF LEASES FOR CERTAIN TERMS.

Two modes of leasing property prevail; the one at the rack, or full rent, or compounding for the same by the payment of a gross sum, the calculations for which have been already considered; and the other by paying a quit-rent less than the real value of the property, and continuing the same on the renewal of the lease, the land-

lord's interest being met by the payment of what is termed a *fine* by the tenant. There is often much dispute about the amount of the fine, it depending on the increase in value of the property, and tables have been constructed to facilitate calculations, the principle being the same with respect to the money being paid in *advance* for the annual rent as explained at the commencement of the article. Fines were originally suggested by the improvement in the value of estates commanding an increased rent; and through the owners being disposed to anticipate an income by a species of mortgage, thus enjoying the benefit of the increased value of the property in preference to leaving it for their successors; in this way, instead of imposing an increased rent spread over a term of years, the original rent is continued and a sum paid down on the renewal of the lease as an equivalent. Property belonging to corporate, collegiate and ecclesiastical bodies is thus leased for terms of 20 or 21 years, a longer term being illegal, excepting houses in towns. Although the original terms were not at first proposed to be extended, the practice of renewal commenced about the time of Henry VII., and it is now regularly covenanted for. Since the reign of Elizabeth, ecclesiastical bodies have been prohibited granting leases of land for a longer term than 21 years, or three lives, but Acts have since enabled them to grant building leases in some localities for 90 years, and chapters grant 40 years leases of houses in towns. When leases are granted for lives, as one dies the life is filled up, and original leases rarely occur, the renewals being granted every seven years. Thus, in a lease granted for 21 years, upon the expiry of the first seven the property is in course of renewal, the original lease is surrendered, a fine paid, and a new lease granted for the same period as the original; copyholds for lives are similarly held of churches and colleges, and the fine is more arbitrary than in leaseholds.

Mr. Scratchley, who has written very ably on the subject, remarks; — "When the period of renewal arrives, three points are to be considered: viz, the annual value of the property, the rate of interest to be allowed to the lessee, and the term for which the lease is to be renewed; all of which might proceed upon certain fixed principles; for instance, it is well known that the estimated value of an interest in reversion depends in a great degree upon the rate of interest which is assumed as the basis of the calculation. If a high rate of interest be taken, the result will be that the fine to be demanded of the lessee upon renewal will be proportionately smaller that it would have been if calculated on the lower rate. In septennial renewals, the fine, if calculated at; —

5 per cent	is	2.92259	Years Value.
6 „	„	2. 4691	
7 „	„	2 090	
8 „	„	1. 7726	

On renewals of leases for lives, the amount of the fine, if properly calculated, will of course vary according to the ages of the existing lives, as well as the rate of interest allowed; and tables have been constructed for the purpose of showing the proper amount of the fine in the case of lives of different ages, at five per cent interest, 6 per cent, and so on."

To ascertain the fine, or sum to be paid for the renewal of 10 years expired in a 21 years lease, allowing the tenant 6 per cent interest, multiply the clear annual rent, that is the net value, after deducting quit rent and other changes, by the value opposite the given term under the proposed rate in the second table.

£ 60 Clear Rent.
$3^3/_4$ Years Purchase for 10 years at 6 Per Cent.
180
45
£ 225 Fine.

It is often covenanted to renew every seven years on the payment of a fine equalling one year's purchase of the estate; in this case the fine to be paid for renewing 10 years of the lease is settled by simply multiplying 1.72, the value opposite ten years in the last column, by the rent, £ 60 = £ 103 „ 11 for the amount of fine. The rules before given apply equally to Renewals in the calculation of the Rent, Number of Years Purchase and Rate of Interest, and it is not essential to repeat them here; but we may as well give a rule for ascertaining the fine to be paid for any term other than 10, 20, 21 and 40 years, for which tables are usually available, as it is impossible to obtain them for all imaginable periods. The rule applies to terms not exceeding 100 years. Refer to the first table at the end of the article and subtract the years purchase of the term held, or unexpired term of the old lease, from that of the whole term to be added, or for which the new lease is to continue, and the remainder will be the years value of renewal; or subtract the value in *money* of the term held from that of the whole term to be added.

30 Years, the whole term proposed at 7 Per Cent = $12^1/_2$ Years Purchase.		£ 40 Rent.
11 Years, unexpired at 7 Per Cent = $7^1/_2$	„	5
Years Purchase of Fine 5	„	£ 200 Fine.

Value of 11 years at 7 per cent £ 40 Rent.
$7^1/_2$ Years Purchase.
280
20
£ 300

Value of 30 years at 7 per cent £ 40 Rent.
$12^1/_2$ Years Purchase.

480	£ 500
20	300
500	£ 200 Fine.

The renewal is in fact a new advance and to be treated as such; the new lease is usually made for a period including the unexpired years with the additional term proposed to be renewed; and the difference between the

value of the lease for the whole term and the value of the unexpired part is the amount of fine. Thus, if there is possession of the unexpired term of a lease for fifty years and it is desired to add twenty to it, or, in other words, to have a fresh lease for the term of seventy years, the fine due for such renewal is equal to the difference between the value of a lease for the whole period of seventy years and that of the unexpired term of fifty years; or it is equal to the *reversion* of a lease of seventy years after the present fifty.

PURCHASE OF LEASES OR ESTATES FOR LIVES.

Leases, etc., dependant on a life or lives are often granted for a definite term, subject, however, to termination if the life or lives expire within the term, which is usually longer than it is probable it or they will continue. The chances of life have been tabulated by various person, and the probabilities differ according to localities. "Estates for lives are of various kinds, some are granted for a single life, of which kind may be considered church livings, tenancies by courtesy, in dower, etc.; and, in fact, all estates which terminate on the extinction of the given life: others are granted for two lives, such as joint tenancies, and joint tenancies with benefit of survivorship, the former signifying such estates as terminate on the death of either of the parties, and the latter signifying such as terminate on the death of both of the parties, that is, after both lives are extinct: others are granted for three lives, which, like the last, may be divided into such as depend on the longest of all the lives; the former signifying such as terminate on the death of any one of the parties, and the latter such as terminate on the death of the last existing one of the three lives. A tenant for life can make no leases to continue longer than his own life; for his leases are absolutely void at his death. When a person holds an estate for the term of another's life, he is called tenant *per auter vic;* and leases made by him of course determine on the death of the *cestui que vie*, or person during whose life he holds, but not on his own death."

To determine the value of a lease held on a single life, bring the rent into a clear annuity, and, referring to the appropriate table, multiply it by the number of years purchase the life on which the lease is held is worth, according to the rate of interest determined upon. The tithes of a rectory are bought on a similar system of valuation or the life of a rector.

Ths value of a lease bringing in a clear annual rent of £ 50 during the life of a person aged 40 years at 7 per cent is thus determined.

By the table for the purchase of leases, annuities, etc., held on a single life, $9^3/_4$ is the number of years purchase; —

£ 50 Clear rent.
$9^3/_4$
450
37
£ 487 „ 10 Present Value.

This is the sum which, put out to interest at 7 per cent, will provide for the payment of £ 50 per annum during the life of a person 40 years of age, deduction being made from each year's rent to provide for the probability of the life becoming extinct.

The value of estates determining on the death of two or more persons, or on the joint continuance of lives, is similarly calculated by reference to the necessary tables.

REVERSIONS OF FREEHOLDS AND LEASEHOLDS AFTER ANY GIVEN LIFE OR LIVES.

To calculate the present value of the reversion of a Freehold or Leasehold after any given life or lives; — deduct the value in money of the given life or lives from that of the lease or freehold; or deduct the value in years purchase, against the given term in the table under the proposed rate of interest, of the life or lives from the purchase value of the lease or freehold, the remainder in the first case being the money value, and in the second the number of years purchase.

Value the reversions of a freehold bringing in a clear rental of £ 100 per annum on the death of a person aged 40, interest at 5 per cent.

Value of Freehold at 5 Per Cent is 20 Years Purchase.
Value of Life at 40 Do. $11^3/_4$ do.
Present Value $9^1/_4$ do.

£ 100 Rent.
$9^1/_4$
900
25
£ 925 Value of Reversion.

£ 100 Rent.
20 Years Purchase.
2000
1175
£ 925 Present Value of Reversions.

£ 100 Rent.
$11^3/_4$ Years Purchase.
1100
75
£ 1175

Value the reversion of a freehold after the longest of two lives, 30 and 40, of a clear rental of £ 150, at 5 per cent.

Value of Freehold at 5 Per Cent is 20 Years Purchase.
Value of longest of two Lives Do. $15^1/_4$ do.
$4^3/_4$

£ 150 Rent.
$4^3/_4$
600
112 „ 10
£ 712 „ 10 Value of Reversion.

The value of reversions on the longest of three lives is similarly calculated, and also those dependant on the joint continuance of lives, reference being made to the appropriate tables. It is the same with leases: deduct the value of the given life or lives from that of the lease. Take a leasehold bringing in £ 50 per annum for a term of

80 years, what is the present value on the death of a person 60 years of age, to pay 7 per cent.

Value of Lease for 80 years at 7 Per Cent is $14^1/_4$ Years Purchase.
Value of Life at 60 „ „ $7^1/_4$ „

Present Value 7 „

£ 50 Rent.
7

£ 350 Value of Reversion.

Calculate on a similar principle in the case of the longest, or joint continuance of, two or more lives.

RENEWALS OF LEASES AND ESTATES FOR LIVES.

Renewals of leases on lives occur in cases when they are granted for lives and, one of these becoming extinct, the tenant desires to put in one of the best lives he can find, if possible under twenty, in order that the estate may continue to be held on the same number of lives, and his interest be lengthened as much as possible. If the property has improved, the landlord will require a proportionate sum of money, and this is also regulated by the age of the proposed life, the rate of interest to be made, and the age of the remaining life or lives with which the new one is associated. Two lives sometimes expire before the lease is renewed, and often the right of putting in the first vacancy is purchased. To settle the correct sums to be paid in the way of fines appropriate tables are used.

Suppose an estate held on three lives (as most usual) of the net rent, after deducting the reserved rent, etc., of £ 150 per annum, held on two lives, aged respectively 40, 50, the third having become extinct, and the tenant desires to put in another life of 15, what is the sum to be given to clear 6 per cent. On reference to a table we find opposite 40, 50, in the division to which the new life 15 belongs and under 6 per cent. 2 years nearly as the purchase value, which, multiplied by the rent, gives £ 150 $\times$ 2 = £ 300 as the sum required for putting in the new life.

MEMORANDA. To find the gain or loss per cent: multiply the sum gained or lost by 100, and divide the product by the sum given; or, as the prime cost is to the sum lost or gained, so is 100 to the rate per cent.

To ascertain the interest on a given sum: multiply the principal by the rate allowed per cent, and divide by 100 for the interest for one year, multiplying then by the number of years.

To find the present value of a sum due some time hence: as 100 with the interest at the proposed rate added to it, is to 100, so is the sum to its present value; or, to obtain the discount, as £ 100 with the interest for the time added is to the interest, so is the total sum to the discount: subtracting the discount from the given sum gives the present value.

MARKET VALUE OF PROPERTY.

Mortgages	Worth 4 Per Cent	or about	25	Years Purchase.
Freehold Land	„ 3 to 4 „	„	28 to 33	„
Freehold Ground Rents	„ 3 to 4 „	„	25 to 33	„
Do. Houses, first and second class	„ 5 „	„	18 to 20	„
Do. Do., third and fourth class	„ 6 „	„	16	„
Do. First class country mansions	„ 4 to 5 „	„	20 to 25	„
Do. London business premises, first class generally			19 to 23	„
Do. London private houses, first class			17 to 20	„
Do. London suburban business premises			16 to 20	„
Do. London suburban private houses			14 to 20	„
Do. Country business premises			13 to 18	„
Do. Country private houses near towns			12 to 16	„
Do. Labourers' Cottages			10 to 12	„
Leasehold Residences generally, —				
First and second class	Worth 6 Per Cent	or about	16	„
Second and third „	„ 7 „	„	14 to 15	„
Third and fourth „	„ 8 „	„	12 to 13	„
Fourth and fifth „	„ 9 „	„	11 to 12	„
Fifth and sixth „	„ 10 „	„	9 to 10	„
Refer to Tables and take terms.				
Retail Trade			1	„
Ready Money Trade			$1^1/_2$	„
Tavern			2 to 4	„

Annual value of land per acre varies from 7 shillings in Durham to 40 shillings upwards in Middlesex.

TABLE FOR PURCHASING LEASES, ETC, FOR TERMS OF YEARS CERTAIN.

Number of Years of Lease etc.	YEARS PURCHASE.							
	3 P. C.	4 P. C.	5 P. C.	6 P. C.	7 P. C.	8 P. C.	9 P. C.	10 P. C.
1	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90
2	1.91	1.88	1.85	1.83	1.80	1.78	1.75	1.73
3	2.82	2.77	2.72	2.67	2.62	2.57	2.53	2.48
4	3.71	3.63	3.54	3.46	3.38	3.31	3.24	3.17
5	4.58	4.45	4.32	4.21	4.10	3.99	3.89	3.79
6	5.41	5.24	5.07	4.91	4.76	4.62	4.48	4.35
7	6.23	6.00	5.78	5.58	5.38	5.20	5.03	4.86
8	7.02	6.73	6.46	6.21	5.97	5.74	5.53	5.33
9	7.78	7.43	7.10	6.80	6.51	6.24	5.99	5.75
10	8.53	8.11	7.72	7.36	7.02	6.71	6.41	6.14
11	9.25	8.76	8.30	7.88	7.49	7.13	6.80	6.49
12	9.95	9.38	8.86	8.38	7.91	7.53	7.16	6.81
13	10.63	9.98	9.39	8.85	8.35	7.90	7.48	7.10
14	11.29	10.56	9.89	9.29	8.74	8.24	7.78	7.36
15	11.93	11.11	10.38	9.71	9.10	8.55	8.06	7.60
16	12.56	11.65	10.83	10.10	9.44	8.85	8.31	7.82
17	13.16	12.16	11.27	10.47	9.76	9.12	8.54	8.02
18	13.75	12.65	11.69	10.82	10.05	9.37	8.75	8.20
19	14.32	13.13	12.08	11.15	10.33	9.60	8.95	8.36
20	14.87	13.59	12.46	11.47	10.59	9.81	9.12	8.51
21	15.41	14.02	12.82	11.76	10.83	10.01	9.29	8.64
22	15.93	14.45	13.16	12.04	11.06	10.20	9.44	8.77
23	16.44	14.85	13.48	12.30	11.27	10.37	9.58	8.88
24	16.93	15.24	13.79	12.55	11.46	10.52	9.70	8.98
25	17.41	15.62	14.09	12.78	11.65	10.67	9.82	9.07
26	17.87	15.98	14.37	13.00	11.82	10.81	9.92	9.16
27	18.32	16.33	14.64	13.21	11.98	10.93	10.02	9.23
28	18.76	16.66	14.89	13.40	12.13	11.05	10.11	9.30
29	19.18	16.98	15.14	13.59	12.27	11.15	10.19	9.37
30	19.60	17.29	15.37	13.76	12.40	11.25	10.27	9.42
31	20.00	17.58	15.59	13.92	12.53	11.35	10.34	9.47
32	20.38	17.87	15.80	14.08	12.64	11.43	10.40	9.52
33	20.76	18.14	16.00	14.23	12.75	11.51	10.46	9.56
34	21.13	18.41	16.19	14.36	12.85	11.58	10.51	9.60
35	21.48	18.66	16.37	14.49	12.94	11.65	10.56	9.64
36	21.83	18.90	16.54	14.62	13.03	11.71	10.61	9.67
37	22.16	19.14	16.71	14.73	13.11	11.77	10.65	9.70
38	22.49	19.36	16.86	14.84	13.19	11.82	10.69	9.73
39	22.80	19.58	17.01	14.94	13.26	11.87	10.72	9.75
40	23.11	19.79	17.15	15.04	13.33	11.92	10.75	9.77
41	23.41	19.99	17.29	15.13	13.39	11.96	10.78	9.79
42	23.70	20.18	17.42	15.22	13.45	12.00	10.81	9.81
43	23.98	20.37	17.54	15.30	13.50	12.04	10.83	9.83
44	24.25	20.54	17.66	15.38	13.55	12.07	10.86	9.84
45	24.51	20.72	17.77	15.45	13.60	12.10	10.88	9.86
46	24.77	20.88	17.88	15.52	13.65	12.13	10.90	9.87
47	25.02	21.04	17.98	15.58	13.69	12.16	10.91	9.88
48	25.26	21.19	18.07	15.65	13.73	12.18	10.93	9.89
49	25.50	21.34	18.16	15.70	13.76	12.21	10.94	9.90
50	25.73	21.48	18.25	15.76	13.80	12.23	10.96	9.91
55	26.77	22.10	18.63	15.99	13.94	12.31	11.01	9.94
60	27.67	22.62	18.92	16.16	14.03	12.37	11.04	9.96
65	28.45	23.04	19.16	16.28	14.11	12.41	11.07	9.98
70	29.12	23.39	19.34	16.38	14.16	12.44	11.08	9.98
75	29.70	23.68	19.48	16.45	14.19	12.46	11.09	9.99
80	30.20	23.91	19.59	16.50	14.22	12.47	11.10	9.99
85	30.63	24.10	19.68	16.54	14.24	12.48	11.10	9.99
90	31.00	24.26	19.75	16.57	14.25	12.48	11.10	9.99
95	31.32	24.39	19.80	16.60	14.26	12.49	11.10	9.99
100	31.59	24.50	19.84	16.61	14.26	12.49	11.10	9.99
Freeholds. Perpy.	33.33	25.00	20.00	16.66	14.28	12.50	11.11	10.00

So that 20 = $^1/_5$; 25 = $^1/_4$; 50 = $^1/_2$; and 75 = $^3/_4$.

TABLE FOR RENEWING ANY NUMBER OF YEARS LAPSED IN A LEASE FOR 21 YEARS.

Years.	3 P. C.	4 P. C.	5 P. C.	6 P. C.	8 P. C.	£ 11.564 P. C.
1	.53	.43	.35	.29	.19	.10
2	1.09	.89	.73	.60	.41	.21
3	1.66	1.37	1.13	.93	.64	.33
4	2.24	1.86	1.54	1.28	.89	.47
5	2.85	2.37	1.98	1.65	1.16	.63
6	3.47	2.91	2.44	2.05	1.45	.80
7	4.11	3.46	2.92	2.46	1.77	1.00
8	4.78	4.04	3.42	2.91	2.11	1.21
9	5.46	4.64	3.95	3.38	2.48	1.45
10	6.16	5.26	4.51	3.87	2.87	1.72
11	6.88	5.91	5.09	4.40	3.30	2.02
12	7.62	6.59	5.71	4.96	3.77	2.36
13	8.39	7.29	6.35	5.55	4.27	2.73
14	9.18	8.02	7.03	6.18	4.81	3.15
15	9.99	8.78	7.74	6.84	5.39	3.61
16	10.83	9.57	8.49	7.55	6.02	4.13
17	11.69	10.39	9.27	8.29	6.70	4.71
18	12.58	11.25	10.09	9.09	7.44	5.35
19	13.50	12.14	10.96	9.93	8.23	6.07
20	14.44	13.06	11.86	10.82	9.09	6.88
21	15.41	14.02	12.82	11.76	10.01	7.77

MEMORANDA OF THE LAWS RELATING TO HOUSES, ETC.

Freeholds. "A tenant in fee-simple is defined to be one who has lands or tenements to hold to him and his heirs for ever." A freehold, in other words, is the *free tenure* of a property for either an unlimited time or a life, and not for a definite period prefixed; fee-tail is restricted to certain heirs.

Leaseholds. A lease is a contract by which the holder of houses or estates, called the *lessor* or *landlord*, conveys them to another party, called the *lessee*, or *tenant*, for years, life, or at will, under defined covenants and conditions, and usually in consideration of either a certain sum paid down, or spread over the term in the shape of rent, or both. The transfer of the whole unexpired term is called an *assignment*, and that of a less period an *under-lease*. A clear title is requisite in the lessor; the covenants must be such as can be performed; the lease must be demisable, and a solicitor must execute, and the lessee accept it. Aliens, who belong to friendly states, may hold tenements and land for residence or business for any term not exceeding 21 years (7 and 8 Vict. c. 66 s. 5).

Copyholds. Copyholds are older than leaseholds, and both landlord and tenant may be obliged to renew; but a copyholder cannot, without licence, grant a lease for a longer period than one year, or by special custom, without running the risk of forfeiture. The services which copyholders were formerly required to render to the lord of the manor are now commuted for a slight quit-rent. To constitute a copyhold, — "it must have existed time out of mind; it cannot begin at this day. There are four circumstances necessary to the existence of a copyhold; — 1, a manor; 2, a court; 3, the lands must be parcel of, and situate within, the manor of which they are held; and 4, the lands must have been demised, or demisable, by copy of court roll from time immemorial." By the beneficial operation of the Copyhold Enfranchisement Act, upon the first change of ownership, the lord, or the tenant, may compel the other to make the estate a freehold, on payment to the lord, on valuation, of an equivalent sum of money.

Having defined generally these three descriptions of property, we shall return to *Leases*, and state the more prominent circumstances connected with these and other tenures.

Assignment. If the total legal interest in lands, rents, advowsons, etc., be yielded up, it is an assignment; or the setting over to another of a right in things, in which a third person, not a party to the transfer, has an interest. The *assignor* is the party assigning, and the *assignee* the

one to whom the assignment is made. Although the lessor may accept rent of the assignee, a lessee continues liable on express covenants. Covenants not to assign or underlet are not to be considered as understood in an agreement to grant a lease with usual covenants; and, while a covenant to restrain underleases prevents assignment, a covenant "not to assign, transfer, or set over" does not include underleases. It is usual to covenant not to assign without consent of lessor. An assignee does not free himself from liabilily unless the whole estate is assigned, for covenants are devisable, and he must answer for what he retains.

Underlease. In what has been already said, we need only add that; — "An underlease of the whole term has been held to amount to an assignment in law; but it appears that such instruments will be good as underleases as between the parties to them." Of course, if a person, having only a three years interest, grants an underlease for four, it will only hold for three.

Surrender is the entire giving up of a lease to the party who owns the reversion, or from the *surrenderor* to the *surrenderee:* it is not made if any interest is reserved; but if the surrender is made on a condition which is unperformed, the term is revived. It is provided by the Statute of Frauds; — "that no leases, estates, or interests, either of freehold or terms of years, or any uncertain interest, not being copyhold or customary interest, of, in, to, or out of, any messuages, manors, lands, etc., shall be assigned, granted or *surrendered,* unless it be by deed or note in writing, signed by the party so assigning, granting or *surrendering* the same, or their agents thereunto lawfully authorized by writing, or by act and operation of law."

Mortgage. Any property may be mortgaged in whole or part, as relates to the property itself or those who may share it. To explain it simply; — "A mortgage is where a man borrows of another a specific sum, and grants him the freehold or inheritance on condition, that if the *mortgagor* shall repay the *mortgagee* the said sum on a certain day mentioned in the deed, that then the mortgagor may re-enter on the estates so granted in pledge; or, as is now the more usual way, that the mortgagee shall reconvey the estate to the mortgagor." The lender in possession is, of course, bound by the covenants attached to the property, and has to pay himself as he can from the rents.

Forfeiture is incurred through breach of covenants, or implied conditions agreed to or understood, always provided that they are not illegal; but the right to enter for forfeiture is limited to a period of twenty years. Distraining for, or acceptance of, rent operates as a waiver against forfeiture, the former being an acknowledgement of tenancy. A tenant cannot forfeit a lease of his own will; the landlord must proceed.

Tenancy for Life. We have remarked on this subject in a former article. Such a tenancy may exist for the period of a man's own life, or that of one or more other persons. Unless the tenant has a special power, he cannot grant leases for longer periods than the life or lives for which he has possession.

Renewals. This subject is also treated in the article alluded to on "the Valuation of Property." "It has long been an established practice to consider those who are in the possession of lands, under leases for lives or years, particularly from the crown, colleges, etc., as having an interest beyond the subsisting term; and this interest is usually denominated *the tenant's right of renewal,* which, though not any certain or even contingent estate, there being no means of compelling a renewal, yet it is so adverted to in all transactions relative to leasehold property, that it influences the prices in sales, and is often an inducement to accept of it in mortgages and settlements."

An Agreement for a Lease will be considered or not as an actual lease according as the intention is evidenced by the phraseology. The words "doth let, agrees to let," etc., constitute a real lease; but an express clause on the subject will prevent misunderstanding. In equity an agreement is held good, but under one, plainly no more than such, a landlord cannot distrain. Usually, acceptance of rent by a party entitled to set aside an agreement, or lease, will confirm it.

Agreements for Three Years need not be stamped. These agreements present many advantages, as there is a certain security of possession and the term is too short for great risk, especially to persons in trade. If possession is not resigned at the end of the term, the tenant becomes an annual one. The agreement should express who is to pay the taxes and keep the premises in repair. The tenant may stipulate for the option of a lease at the end of the three years.

Annual Tenancies. Houses not taken under a lease, or agreement, as before mentioned, are held on an annual tenancy, unless there be an understanding to the contrary, no matter at what periods the rent is paid. The tenant has a right to make a *sub-tenancy* without the landlord's consent, unless otherwise stipulated; and a yearly tenant may thus underlet or assign his term. He is, however, liable to the landlord for the rent, but if the latter accepts it from the under-tenant the case is altered, and the responsibility of the old tenant is terminated. If the tenant dies, his personal representative must answer for him. If, after the expiry of a lease, possession is retained without a fresh contract, the tenant is considered as one from year to year, at the former rent after the first acceptance of it by the landlord; previous to this he is a tenant at will; and a yearly tenancy is created by a person coming into possession with the landlord's consent, in the place of another tenant. Possession is terminated by a notice, on either side, of *six months,* to quit at the period of the year when the tenancy commenced; so, when houses are let from year to year, on agreement that either party may put an end to the tenancy at a quarter's notice, this must be given to expire at the period of the commencement of tenancy. A month or weeks notice suffices when houses are taken for these terms. If possession is taken previous to the regular quarter day, it is preferable to agree and pay for the odd period and then begin regularly. Should the landlord require an increased rent, he can state it on his notice to quit, when the retention

of possession after the due period for leaving will bind the tenant to the additional rent; if such notice is not given and the tenant remains, a suit of ejectment, or application to the County Court, is essential to eject him. In a tenancy created by word of mouth, a similar notice to quit may be given; but notice in writing is preferable, and delivery must be proved; errors in Christian name, if the notice is retained by the tenant, will not avail him, but an address is not absolutely essential if delivery is proven. A second notice is a waiver of the first; and receipt of, or distraint for, rent after expiration of notice to quit waives such notice.

Tenants at Will and on Sufferance. "If an agreement be made to let premises so long as both parties like, and reserving a compensation, accruing *de die in diem*, and not referable to a year, or any aliquot part of a year, it does not create a holding from year to year, but a tenancy at will strictly so called; and though the tenant has expended money on the improvement of the premises, that does not give him a right to hold them until he be indemnified." A tenant, who holds during the life of another person, and continues in possession after the death of the latter, is a tenant at sufferance. If possession is not demanded prior to turning out a tenant at sufferance, he can maintain an action of trespass, but not one of ejectment. Continuing in possession without right to do so, although the tenancy may have been originally lawfully commenced, constitutes a tenant on sufferance, who holds wrongly, as a tenant at will holds rightfully.

Lodgings. There is no distinction between lodgers and other tenants so far as relates to notices to quit and the payment of rent. The time for the payment of the rent regulates the notice to quit, which must be given so as to terminate occupation at a period corresponding to its announcement; other notices are illegal. Lodgings taken for a certain time, with the understanding that the tenancy is then to cease, obviate any necessity for a notice to quit; continuance of possession after the term will involve a proper notice. Agreements should specify time of entry, and length of notice to quit, and contain a schedule of the furniture, if any.

Annual lodgers should see for what term the housekeeper holds the premises. A landlord may recover the rent from a lodger who quits an apartment without notice, although the former may have put a bill up to let it and used fires in the rooms; but, if he lets the apartment, the contract is nullified. The lodger is not justified in leaving without notice, even from a reasonable fear that his goods may be seized to discharge the landlord's rent. If the lodger leaves with his rent in arrear, the landlord may take possession of the apartment with a constable, and sell the property in it, if not claimed by the owner before the expiry of fourteen days notice given in the London Gazette. In other cases go to the County Court; the rent may be recovered for the period of absence without notice to quit, provided the apartment is not relet. If a lodger will not leave, give the proper notice to quit, adding the amount of rent for continuance.

Stipulations and Covenants in Leases. On the *landlord's* part; — Insert clause to prevent assigning or underletting, as in the case of the death of the tenant some "assign" of no substance may come into possession; bind tenant to insure in the *joint* names of himself and landlord; if rent is not stipulated to be paid quarterly, none can be demanded in less than a year; if tenant is doubtful, stipulate for rent to be paid in advance, as distress can only be levied for rent in arrear; a clause for the rent to be paid weekly, if demanded, will prevent the tenant moving before it is due; power of re-entry should be given in case of bankruptcy, non payment of rent, etc.; tenant to pay rates and taxes; if land tax and sewers rates are not named the landlord will have to pay them; no agreement can oblige tenant to pay landlord's property tax; tenant has to pay expense of lease, although not stipulated; require tenant to repair and uphold premises; secure power to put up bill and allow people to see house during last three months of tenancy; fix a penalty for violations of covenants, as breaches of ordinary clauses will generally result, on an action being brought, in very slight damages; the stamp must be sufficient and impressed within 14 days; prevent carrying on particular trades and building. On the *tenant's* part; — See whether notice to quit is to be so given that tenancy terminates at the corresponding date to commencement; put clause for assignment or underlease not to be refused to a respectable party; in covenanting to repair and uphold except cases of damage by fire, tempest and storm, and make landlord agree to make good or rebuild with all possible despatch; if fixtures are purchased, changes may be made, but if they are included in the rent, they must be left as found at the end of the term; and a clause should be inserted to oblige landlord to repurchase the fixtures, with reasonable alterations, by valuation; call in surveyor to ascertain what is requisite in the way of repairs and alterations, and obtain agreement from landlord to execute these to the satisfaction of the surveyor, fixing a time for completion with a penalty; insert clause "at reasonable times," or within certain hours, for right of viewing premises, and after a certain notice; in underletting, etc., insert all the covenants in the original lease; except "in case of fire" from quarterly payment of rent; may agree for expense of lease to be divided between landlord and tenant.

Having considered the kinds of tenure and the usual conditions and covenants we have next to dispose of some other matters which require explanation.

Fixtures. Schedule to the lease all landlord's fixtures, such as those fixed to the freehold, closets, dressers, mantel-pieces, etc., and also tenants fixtures, shelves, bells, stoves, etc. It is convenient for the tenant to purchase fixtures, as he can then make alterations; and he should stipulate for the landlord to repurchase them at the end of the term with any reasonable additions. The tenant's right to remove his fixtures extends only during his tenancy; he must replace fixtures, not his own, removed for others, and make good any damage sustained through removal. Fixtures are things fixed to the freehold, personal chattels annexed to the building, or let into the soil and connected with it.

Thus buildings on blocks, plates and rollers resting on brickwork, but not affixed, are removable. Permanent fixtures of convenience or ornament cannot be removed, as a conservatory, but, if for the purpose of trade, it can be taken away; a pump slightly fixed is a tenant's fixture; window sashes, not hung, but only fastened by laths nailed across the frame, are removable. Whatever a tenant affixes to the premises becomes part of it, and it is waste to remove it without the landlord's permission. Wainscot, floors, doors, and articles fixed with nails, cannot be removed, but things put up with screws, glasses, bookcases, closets fixed with holdfasts, ranges, coppers, cisterns, etc., can be taken away; articles laying on the soil are not fixtures, but verandahs and summer houses, with posts let into the soil, are not to be removed. If other chimney pieces and doors are substituted for the originals, they may be taken away and the old ones restored, all damage being made good. If the tenant purchases fixtures he may remove them notwithstanding the injury thus caused. Things affixed for trade purposes can be taken away, if it can be done without destruction of their *integral character*, but this does not apply to farmers. Coppers, furnaces, vats and machinery may be removed, but substantial additions to premises are not so distinctly excepted. The following are removable; — "hangings, tapestry and pier glasses, whether nailed to the walls or panels, or put up in lieu of panels; marble or other ornamental chimney pieces; marble slabs; window blinds; wainscot fixed to the walls by screws; grates, ranges and stoves, although fixed in brickwork; iron backs to chimneys; beads fastened to the walls or ceilings; fixed tables, furnaces and coppers, mash tubs and fixed water tubs; coffee and malt mills; cupboards fixed with holdfasts; clockcases; iron ovens and the like. It must, however, be remembered that things can be removed only when the separation will occasion but little or no damage."

The valuation of fixtures is usually made between the outgoing and ingoing tenants, rather than between the landlord and tenant.

Dilapidations are "whatever state of repair a tenement may be in worse than it ought to be."

Permissive dilapidations arise from passive negligence; *commissive* imply active destruction.

Substantial repairs, the amendment to damage, apply to the main constructive parts of a building; all other repairs are *tenantable*, *ordinary* or *necessary*, the former being lasting, and the latter applying to windows, doors, shutters, etc.

Reinstatements apply to things removed or taken away. *Voluntary* or *actual waste* is of *commission*, and *permissive waste* of *omission* to repair; waste being generally whatever does a lasting damage to the freehold. A tenant is liable to repairs even if not so stipulated; but his liability is confined to voluntary negligence and tenantable repairs; not those arising from fire, wear and tear, and accident, or permanent repairs, as new roofing, but he must keep the premises water-tight. If, indeed, there is no express contract, a tenant will often have to rebuild in case of fire, and he is not exempt from rent through a covenant putting rebuilding on landlord. Making alterations to the injury of the lessor is waste, as is also cutting timber, and rebuilding in a different fashion, converting two rooms into one, or a brewhouse into dwellings of more value. Notwithstanding a building is out of repair at the commencement of the term, it is to be left in tenantable condition. No alterations can be made without the landlord's permission, and new erections must be left in proper repair. A yearly tenant is only bound to tenantable, not constructive repairs, that is, to repair injuries from voluntary negligence, not those arising from accident, wear and tear, etc. Tenants at will are not liable to repairs from fire, for which, under a general covenant, lessees are liable, as also in case of floods. Timber may be cut for ecclesiastical repairs. Unless leases are made "without impeachment of waste" the tenant is liable to such impeachment if he cuts timber etc.; otherwise he has great liberty. The burden of repair is, as a general rule, thrown on the tenant as much as possible, because it would not be just to make the landlord pay for accumulated dilapidations, when originally a slight sum expended would have stopped them. The length of term by which the tenant holds affects his obligation; and, although ordinary decay may be said not to be a breach of covenant to keep in repair, there is, nevertheless, a leaning against the tenant tending to oblige him to sustain and uphold, as well as merely repair; and this is not obviated by the fact of the premises not being in repair when entered upon. A landlord must, however, be able to show that the dilapidations accruing are such as were stipulated for the tenant to make good. A yearly tenant is liable for the rent between a fire and the end of his tenancy. It is often difficult to decide what is dilapidation; thus weather-boarding broken is dilapidation, but not if decayed from age, so long as the covering is entire; injury to the internal parts of buildings from want of external reparation is always dilapidation. Fair wear and tear is not dilapidation, but accident is; so we perceive the difference between breaking away the nosing of a step and its being only worn. Decay from inattention, want of paint, etc., is dilapidation. Timber which stands, although decayed, is not dilapidation, but, if it breaks down, the tenant must make good all damage. "A tenant from year to year," says Lord Kenyon, "is bound to commit no waste, and to make fair and tenantable repairs, such as putting in windows and doors that have been broken by him, so as to prevent waste and decay of the premises." For the survey of dilapidations there are three periods; first, during the continuance, in the former part of the term; second, when near its expiry; and third, after its conclusion; and surveys during the continuance of a long lease should be made at least once in ten years. In the first case, draw up a specifications of repairs and reinstatements necessary of dilapidated parts, and, if these are unperformed, an action of ejectment for breach of covenant lies against the tenant within three months. If the survey is made towards the expiry of the lease, or within the last twelve months, make out a schedule of the repairs and reinstatements, assessing the sum to be paid by the tenant electing not to execute

the works, and as a compensation for the deteriorated state of the premises, worse than they ought to be. The interests of both landlord and tenant are met by the compensation money; for the tenant is really put to less expense, and the sum he pays can be better laid out, in connection with additional money the landlord may expend on the house, instead of the tenant patching up the place with forced reparations. A lease is forfeited if repairs are not executed after notice, within the given time; and, although a notice to repair is not essential to sustain an action for repairs unperformed after the expiry of a lease, it is necessary during its continuance. With respect to the value of repairs, cases seldom occur in which the demand of more than three-fourths of the value of new work could be maintained, and few, where one quarter could not be properly demanded. The condition of premises worse than they ought to be has to be considered, and the repairs *assessed;* thus, for broken plastering and glass, if £ 1 is the full cost, assess it at 16 shillings. The appraisement and valuation of estates and effects must be stamped, and the expense is generally borne by the landlord. Dilapidated houses are often let on building and repairing leases at less than the actual value, on the condition of being left in a good state of repair at the expiry of the term; in such cases the repairs are to be valued in full, instead of being assessed. The subject of dilapidations is altogether not so clearly explained as a proposition in Euclid, and many writers have contributed greatly to increase the confusion of the law, which will not, we hope, be said of ourselves.

Rent and Taxes. Rent is not due until midnight of the day on which it is reserved, although the demand, or tender, should be made before sunset according to law. Security, in the shape of a bond, bill, etc., does not invalidate the landlord's right to take proceedings in the case of rent in arrear. Nothing is due till the end of the year, if no mention is made of quarterly or half yearly payments. Proceedings for non-payment, when the tenant remains on the premises, cannot be taken till the day after rent is due; and nothing can excuse non-payment, not even the fact of the house being blown or burnt down, unless the landlord has agreed to the contrary. If, as is usual in annual tenancies, the landlord agrees to keep the premises in repair, and they become so dilapidated as to be unfit for occupation, the tenant is justified in leaving, on giving a written notice, without liability for the last quarter's rent. If such repairs are essential for safety, and the landlord will not execute them, the tenant may, and tender the amount so paid as towards the rent. Money lost by forwarding it by post at the landlord's desire, cannot be recovered from the tenant. An agent employed by a landlord to collect rent must be authorised by letter or power of attorney. Receipts for taxes, payable by the landlord, may be tendered as towards the rent. A receipt for the last quarter's rent covers former arrears.

The landlord pays ground rent and property tax; if the tenant agrees to pay the latter, it is void and illegal. Land tax and sewers rate, together with ground rent, are payable on the premises, but are to be deducted from the rent, unless otherwise stipulated for with respect to one or the other; the law fixes all on the landlord.

The tenant must claim his deductions at the period for payment of rent, and cannot do so afterwards: obtain from landlord clearance of all rates and taxes in arrear up to commencement of tenancy. The taxes and rates payable on the premises, and not yet mentioned, are House Tax, Church Rate, Water Rate, Poor Rate, Police Rate (the latter sometimes included with County Rate under the head of Poor Rate) and Cleansing, Paving, and Lighting, often included with County Rate under heading of Conjoint Rate. Arrears of parochial and local rates and taxes *cannot* be recovered from a new tenant, but it is otherwise with parliamentary taxes, which are payable on the premises; and, in fact, the arrangement with the landlord cannot be too clear on these subjects. The land tax, we may remark, is a perpetual one of four shillings in the pound, as assessed on estates in the reign of William III., and it can be *redeemed* under certain conditions. The house tax is levied on houses of the rent of £ 20, and upwards, 9d in the pound on private houses, and 6d on business premises. The poor rate is charged on the profit of possession of the occupier, the landlord not being liable on his rent. The sewers rate is charged on all who derive benefit from them, although it may not be immediate: the commissioners assess at discretion. County rates are levied for county purposes, bridges, gaols, etc.; and highway rates go to form and maintain them. The owners of houses, not exceeding £ 10 annual value are liable for water rates, in lieu of the occupants. Water supplied to a receptacle 6 ft. 6 ins. above the pavement in front of a house is high service.

Distress. Ejectment. To enlarge on these subjects would occupy too much space. *Distress* is the seizure of personal chattels for rent in arrear: it cannot be made after tender of the rent; and the landlord cannot sell before the expiry of five clear days, exclusive of the days of distraint and sale. Distraint cannot be made under an agreement for a lease, or unless there be an actual demise at a fixed rent. A landlord is liable for the conduct of his agent; but if the distress is legal, the agent answers for irregularities. Things sent to remain in a place can be distrained, but not those sent to be wrought upon by a tradesman; and the tools for trades, the books of a scholar, apparel worn, and fixtures to the freehold, are exempt, if there is in the two former cases, anything else for sufficient distress. Except in the case of goods fraudulently obtained, the outer door of the premises can in no case be broken open to make distress. *Ejectment* is simply the process of recovering possession from persons illegally holding beyond their terms, or in cases of desertion.

Agents. An agent may be commissioned verbally, but requires authority in writing to grant leases, and a deed to make a deed; the adoption of the act of an agent by his employer relieves the former; and tacit acquiescence in the employer will be taken for concurrence. The principal is liable if his bailiff or agent seizes goods priviledged from distress.

Stamps. Agreement, not under seal, may be stamped

within fourteen days of signature, but, in other instances, the paper or parchment must be previously stamped. Mistakes as to the proper amount of stamps will not avail, but, on the payment of 10 shillings, the Commissioner of Stamps gives an opinion, which cannot be set on one side. Appraisements, or valuations of estates and effects, dilapidations and repairs, must all be stamped, and appraisers must be licensed, and return valuations or appraisements to their employers within fourteen days; only one stamp is requisite where the total amount is set down, although there may be several sheets of paper.

With respect to the valuation and appraisement of estates, houses, etc., the Stamp Acts do not apply to appraisements made for private information only, but to such, as are intended to be binding between the respective parties.

Points in Houses. Look round neighbourhood, and see to its character, and if there are nuisances and annoying trades, etc.; consider site, if high or low, soil and subsoil, aspect and prospect, distance from shops, railways, conveyances, post office, schools, church, medical advice; note state of roads, pavements, lighting, sewage, supply of water; observe build of house, as well as accomodation, and how long erected; examine sashes, shutters, doors, and closets, with their fastenings and freedom of action, whether chimneys smoke (look to ceiling), the walls are damp (see to looseness of wall paper, etc.), if the roof is sound (note ceilings under it and go outside), and detect any unpleasant smells indicating defective trapping to drains; remark character of fixtures and their value; calculate cost of additions, alterations and repairs, or get landlords undertaking to do certain repairs, painting, papering, reinstating, broken glass, etc., by a definite time, examine stabling, conservatory, land and pleasure grounds attached, if adjoining ground can be had for additions, and on what terms: on the tenure, rent and taxes the prior remarks will aid decision; and it now only remains to express our acknowledgements to Woodfall's "Law of Landlord and Tenant," from which we have quoted, as perhaps the clearest work on the subjects treated.

E. L. Tarbuck.

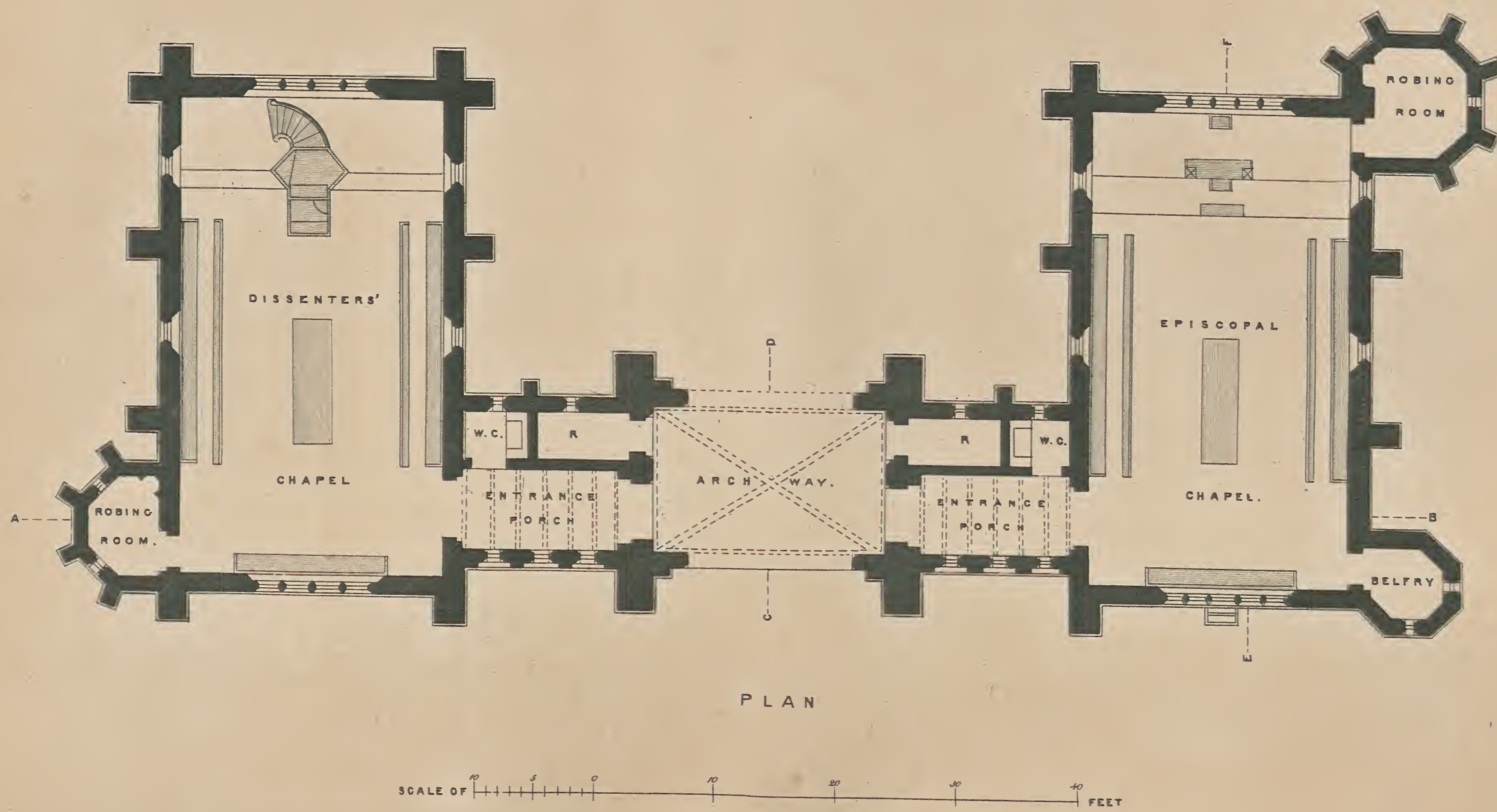
THE END.

Printed by J. F. Klöber, Leipzig.

INDEX OF GENERAL SUBJECTS TREATED.

INDEX OF DESCRIPTIONS TO PLATES.

DESIGNS FOR CEMETERY CHAPELS.



PLAN

E. L. Tarbuck. Architect.

A. H. Payne sc

Designs for Cemetery Chapels.

Dissenters' Chapel.

Episcopal Chapel.

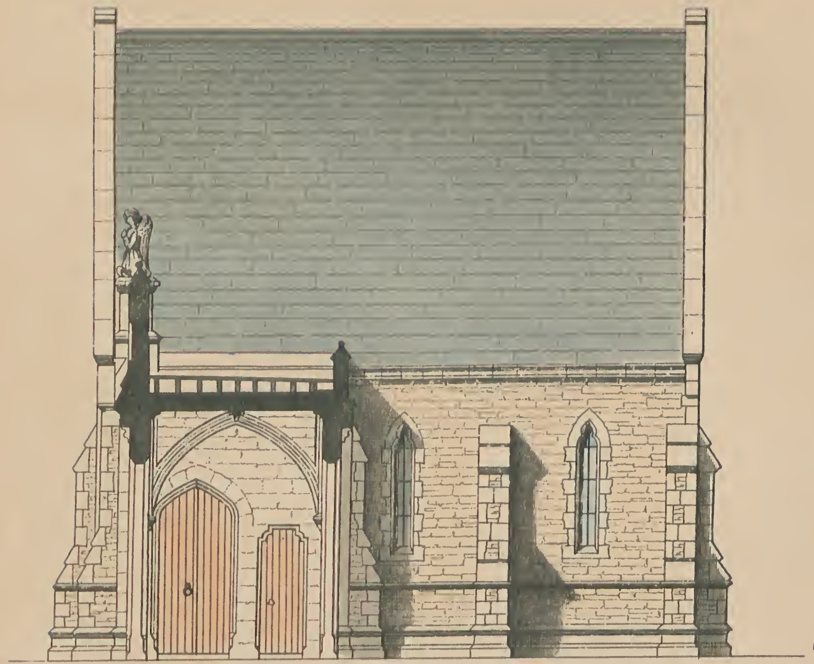
Front - Elevation.

Scale of 10 5 0 10 20 30 40. Feet.

DESIGNS FOR CEMETERY CHAPELS.

SECTION ON LINE A. B.

E L Tarbuck. Architect

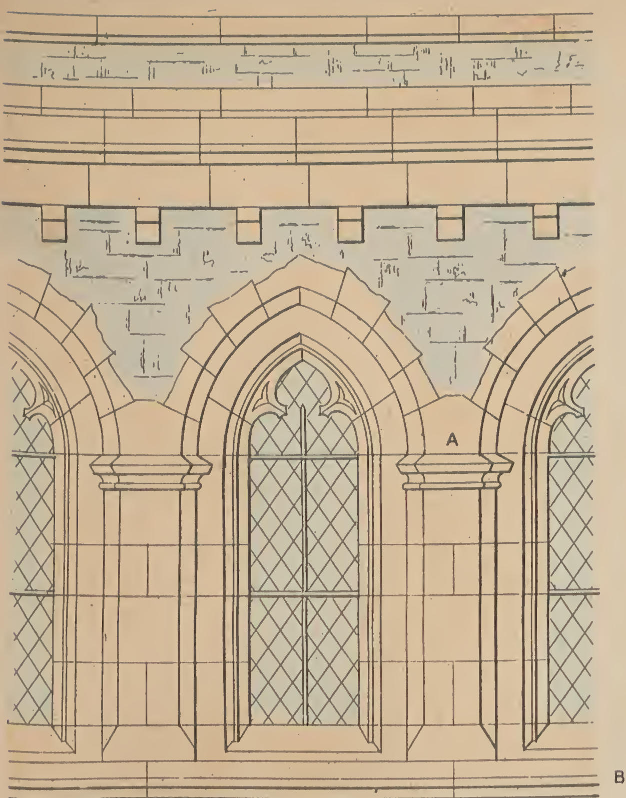


SECTION ON LINE C.D.

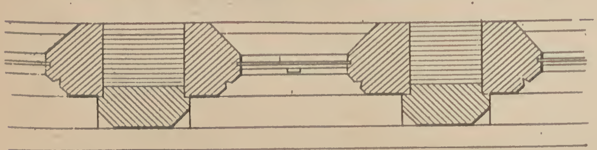
SECTION ON LINE E.F.

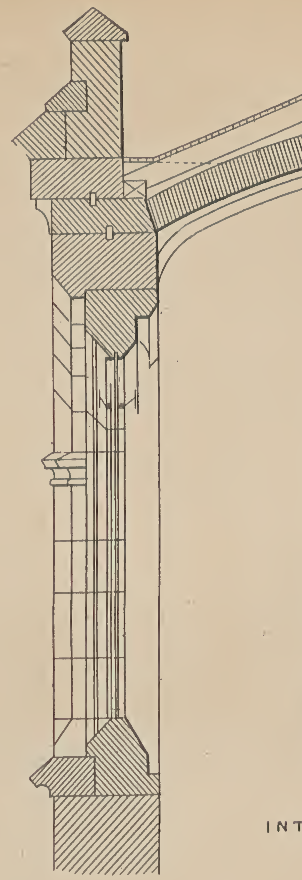
SCALE OF FEET.

MASON'S DETAILS.

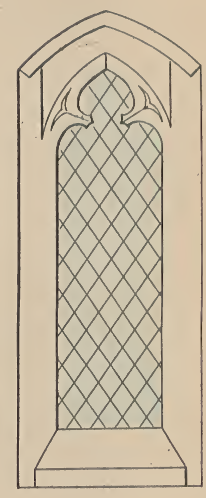


ELEVATION AND PLAN OF ARCADE WINDOWS





SECTION



INTERIOR ELEVATION OF WINDOW

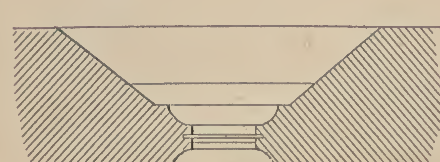
SIDE WINDOWS TO CHAPEL

ELEVATIONS

DETAIL A.

DETAIL B.

DETAIL OF PLINTH



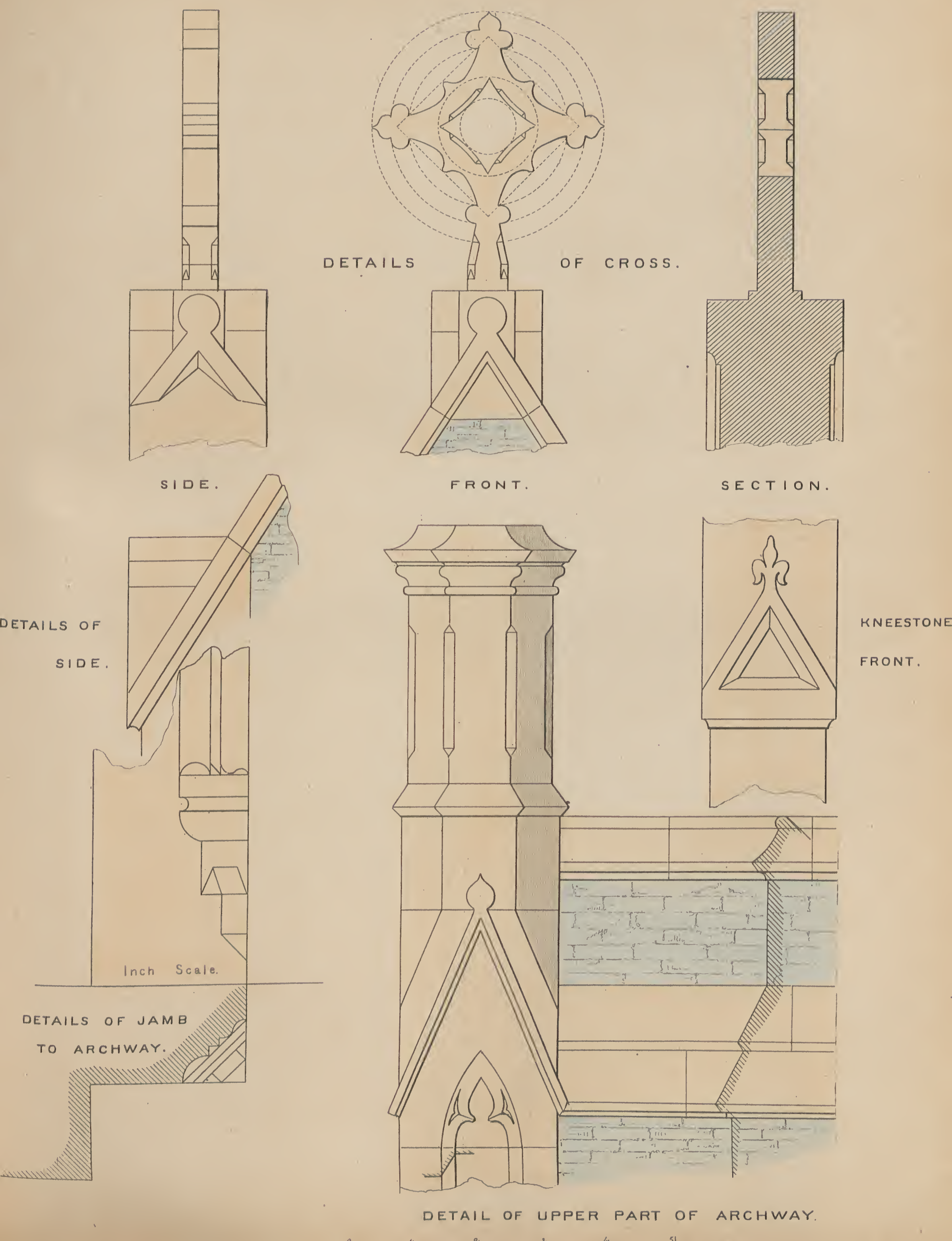
PLAN

SECTION

SCALE OF 5 4 3 2 1 0 5 FEET

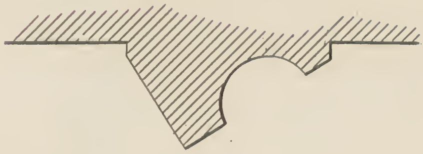
DESIGNS FOR CEMETERY CHAPELS.

MASON'S DETAILS.



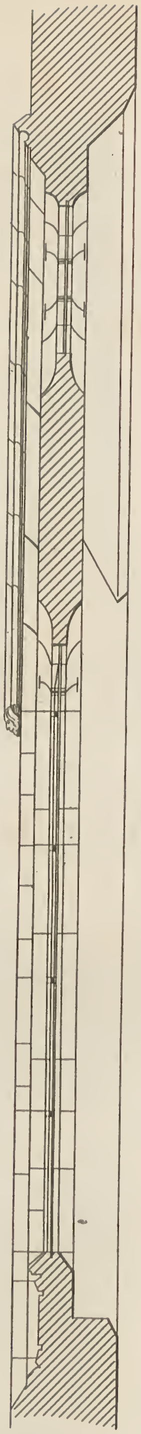
Mason's Details.

Window Episcopal Chapel.



Label

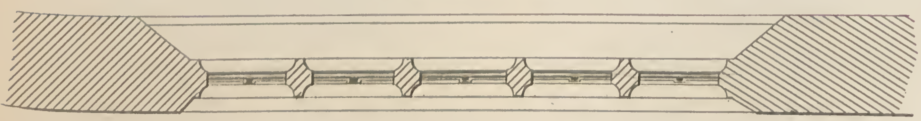
⅛ real size.



Exterior. Interior.

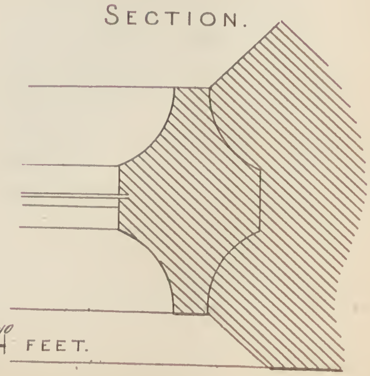
Section.

Elevations.



Plan.

Scale of 0 1 2 3 4 5 6 7 8 9 10 feet.

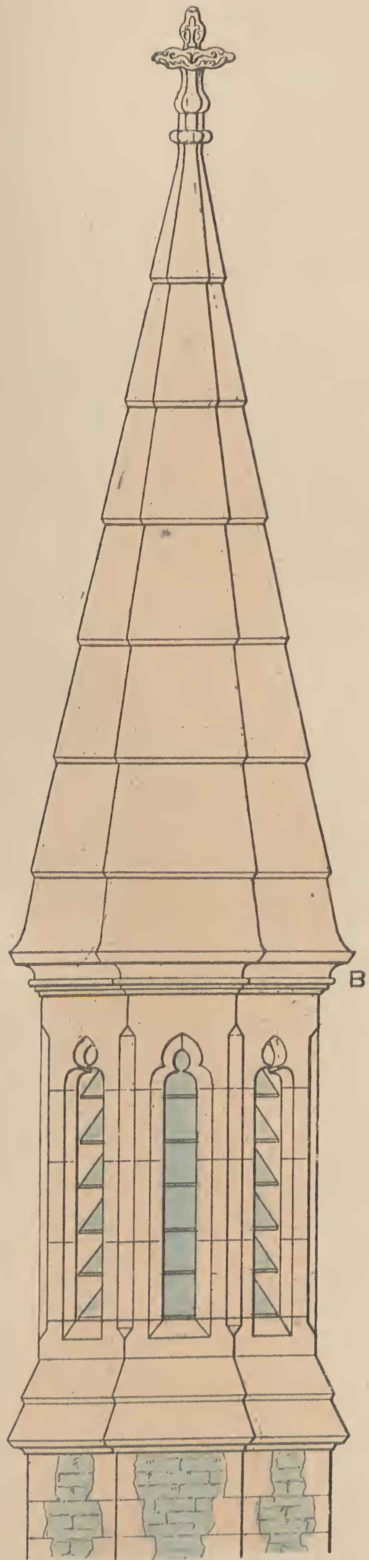


Jamb

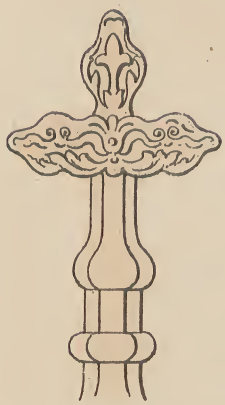
⅛ real size

MASON'S DETAILS.

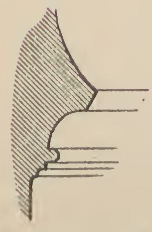
—TURRET—



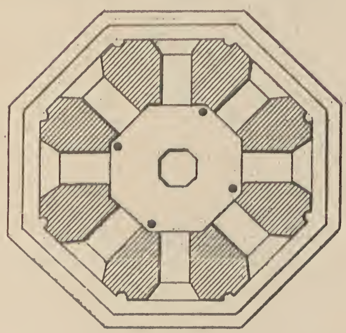
ELEVATION



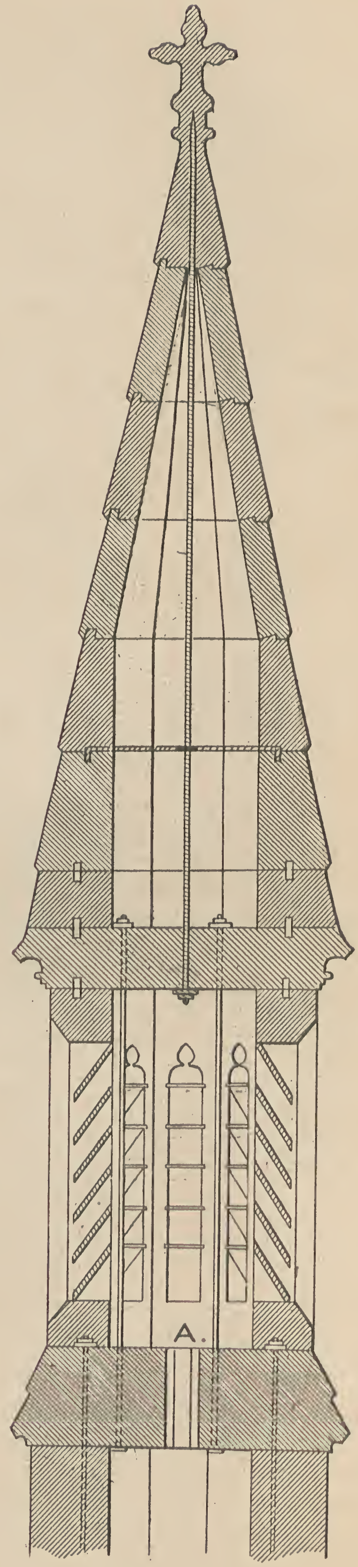
DETAIL OF FINIAL.



MOULDING B.



PLAN AT A.



SECTION.

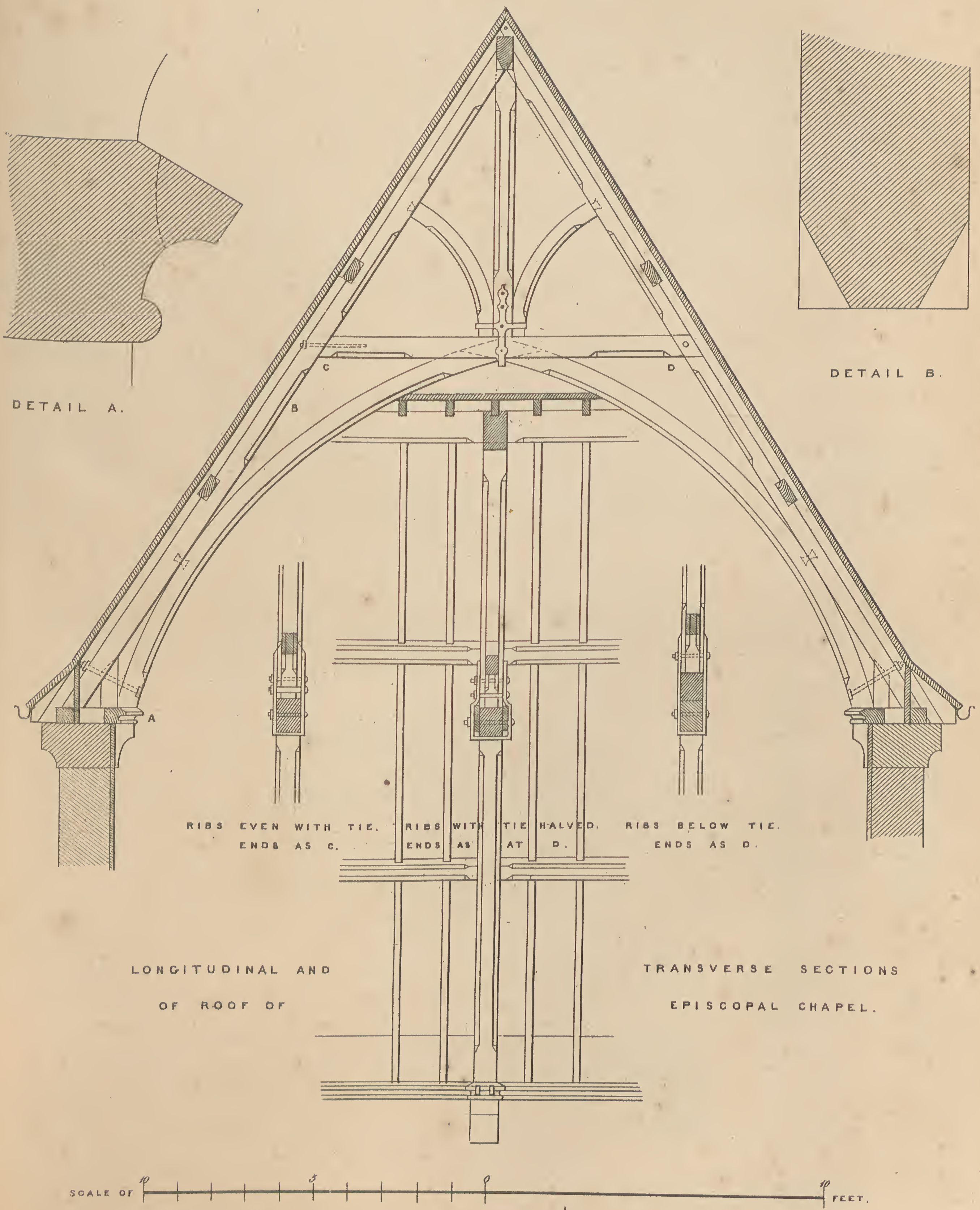
SCALE OF  FEET.

E L Tarbuck Architect.

A H Payne sc.

Designs for Cemetery Chapels.

Carpenter's Details.

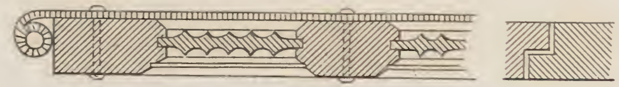


L. Tarbuck. Architect.

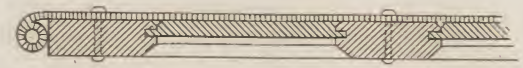
A. H. Payne

DESIGNS FOR CEMETERY CHAPELS.

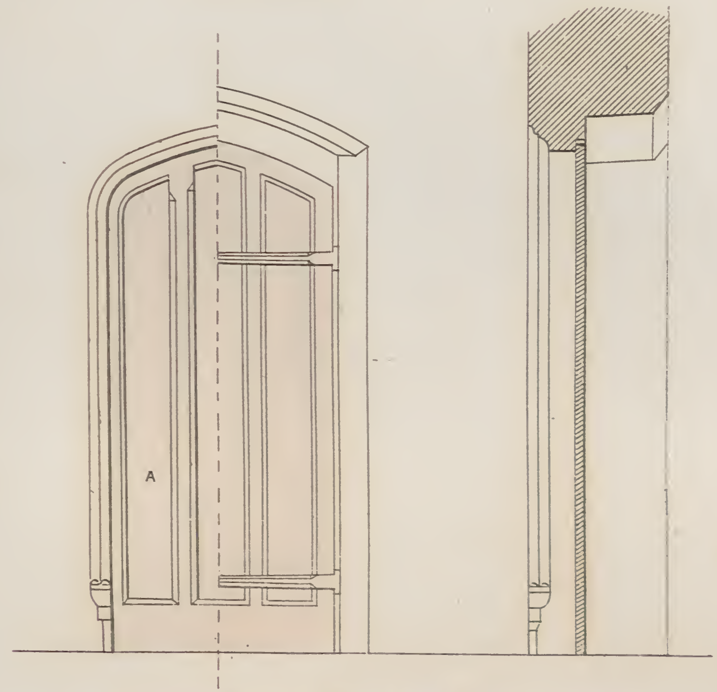
JOINER'S DETAILS.

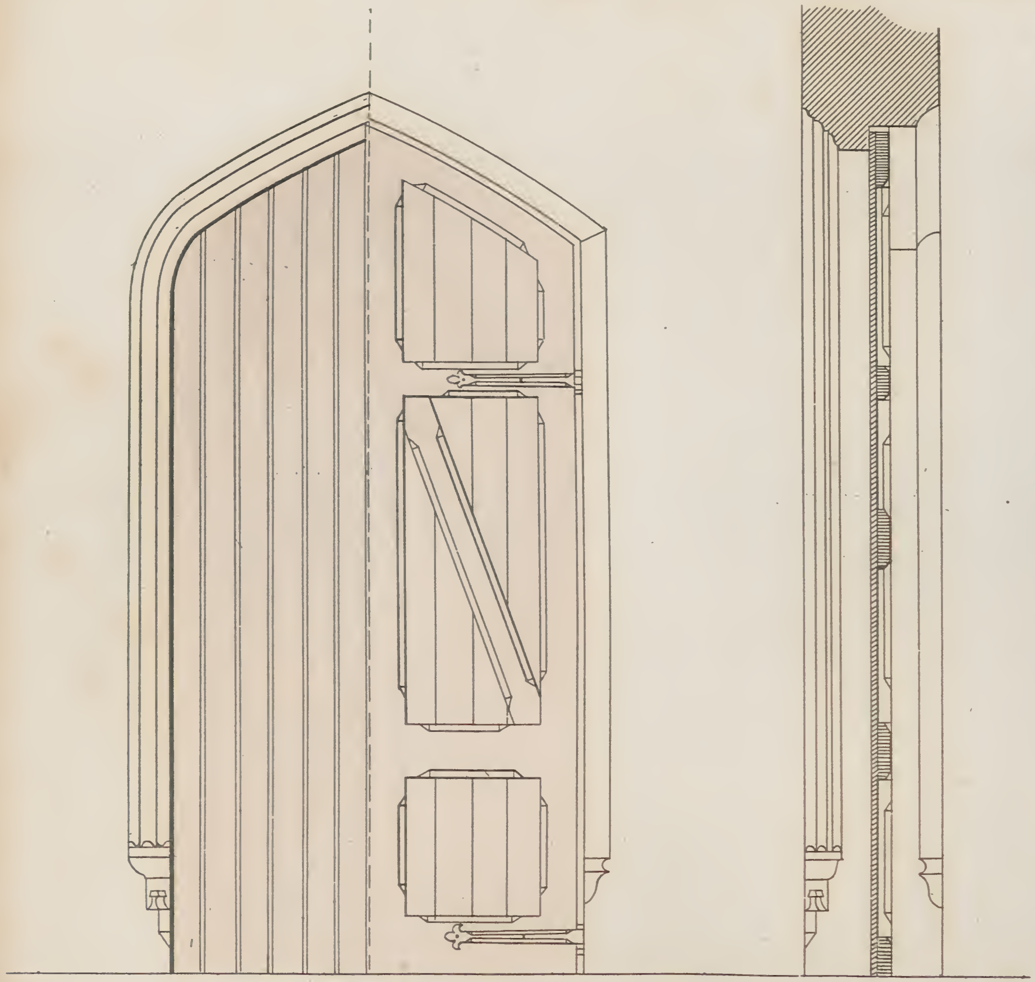


ENTRANCE DOOR TO CHAPEL
1/8 th REAL SIZE



DETAIL A





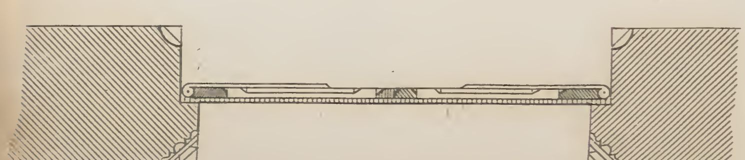
ENTRANCE DOOR TO PORCH

ELEVATION SECTION

PLAN

DOOR TO BELFRY AND ROBING ROOM

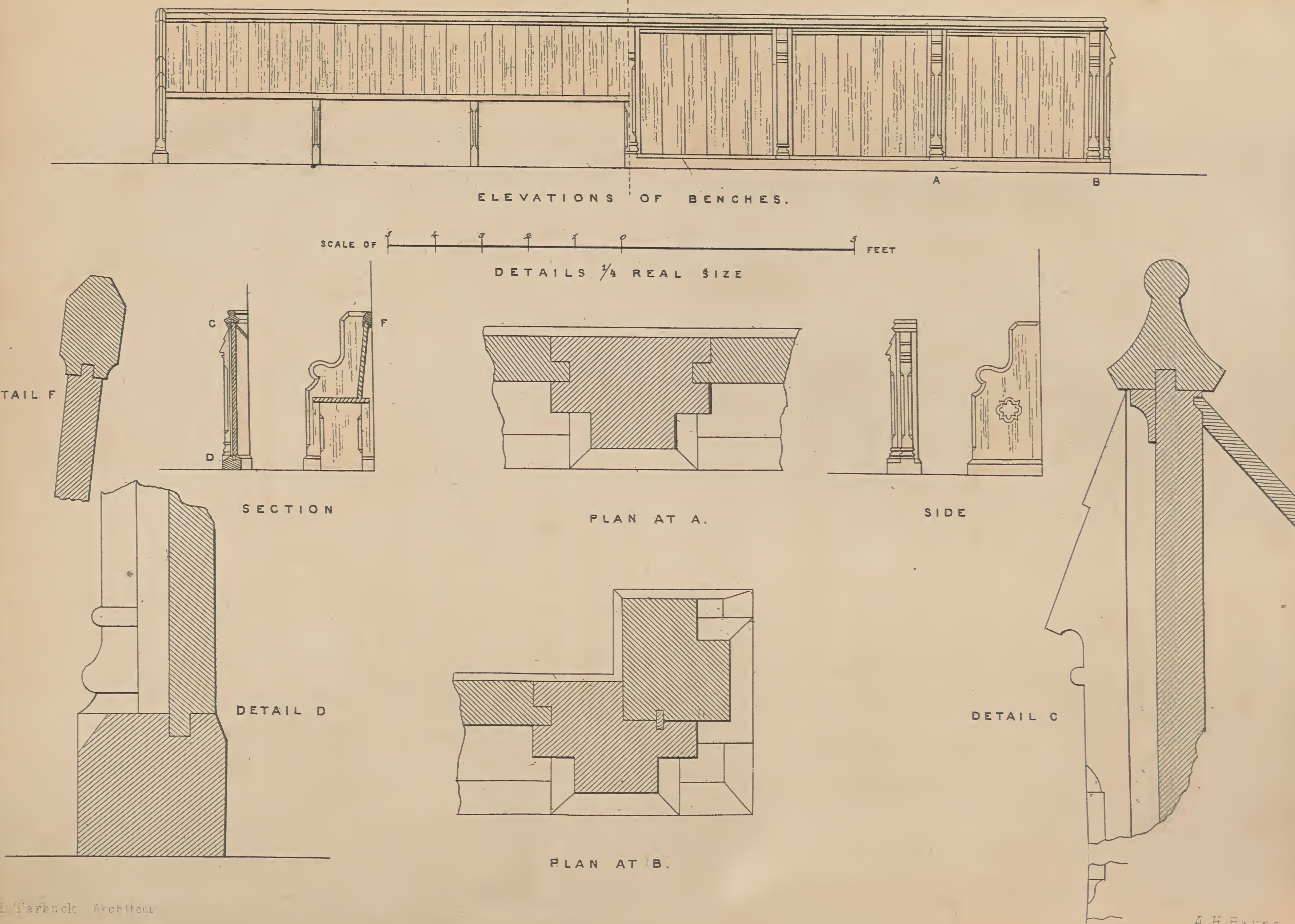
ELEVATION SECTION



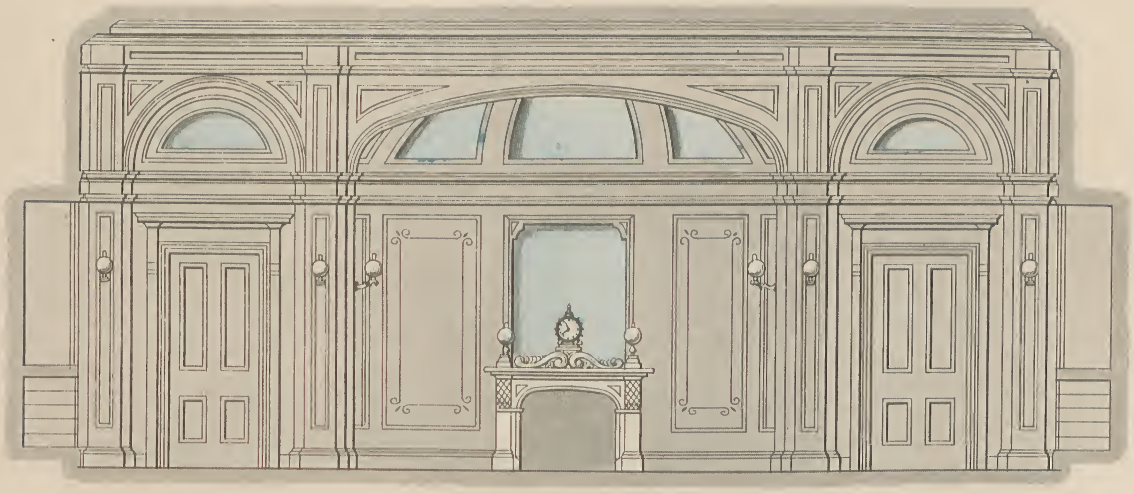
PLAN

DESIGNS FOR CEMETERY CHAPELS.

JOINER'S DETAILS.

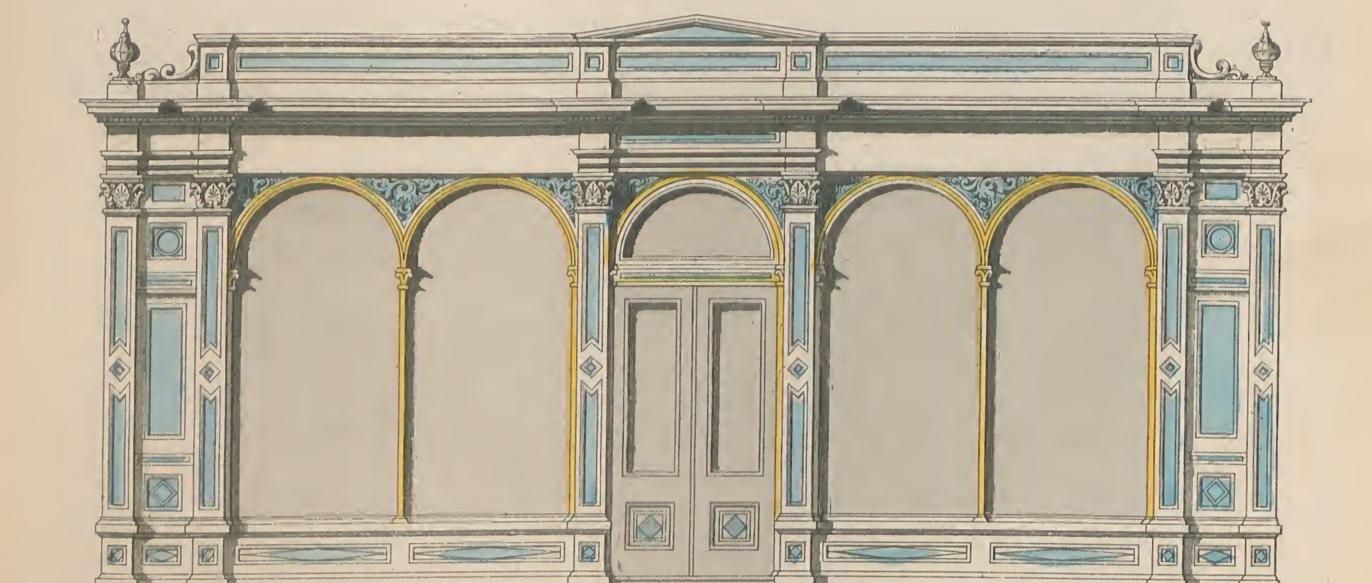


DESIGNS FOR SHOP FITTINGS.

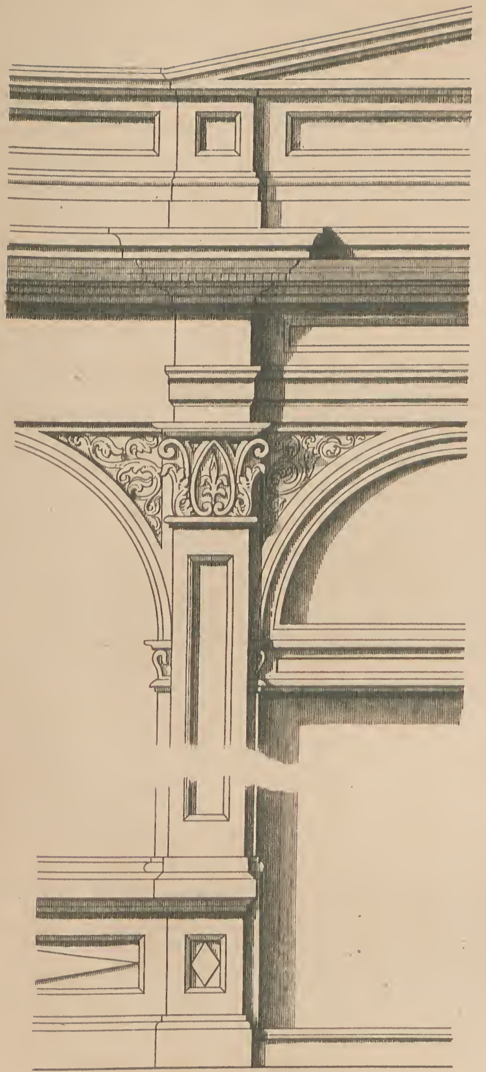


TRANSVERSE SECTION.

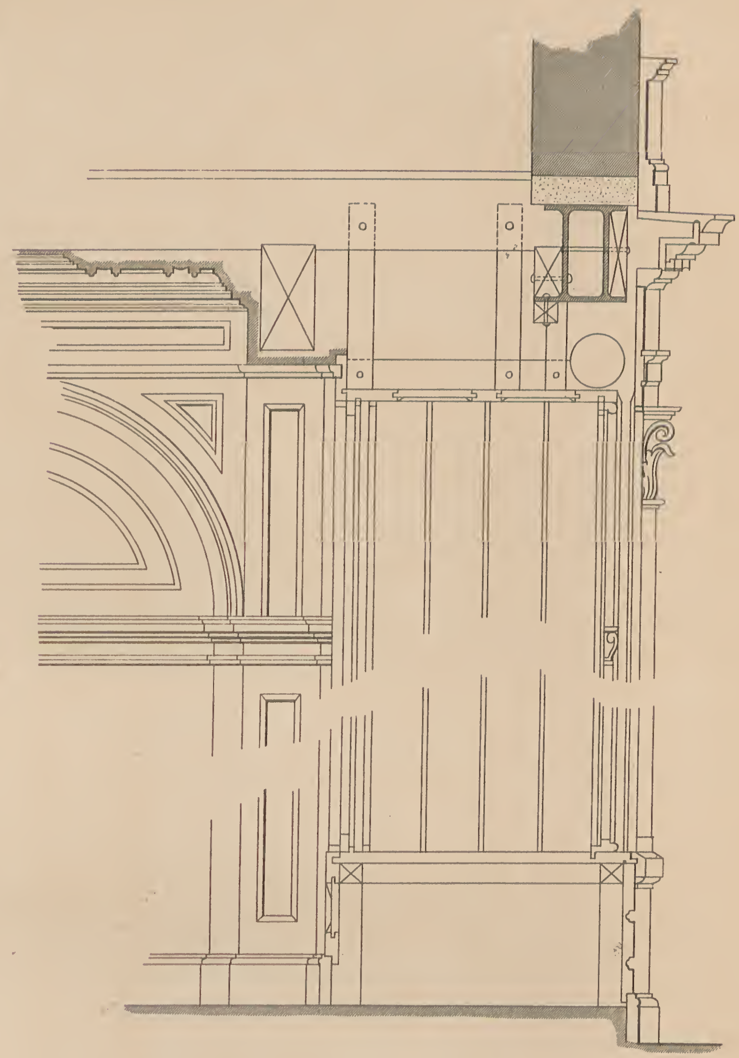
SCALE OF 0 5 10 15 FEET.



EXTERIOR ELEVATION.

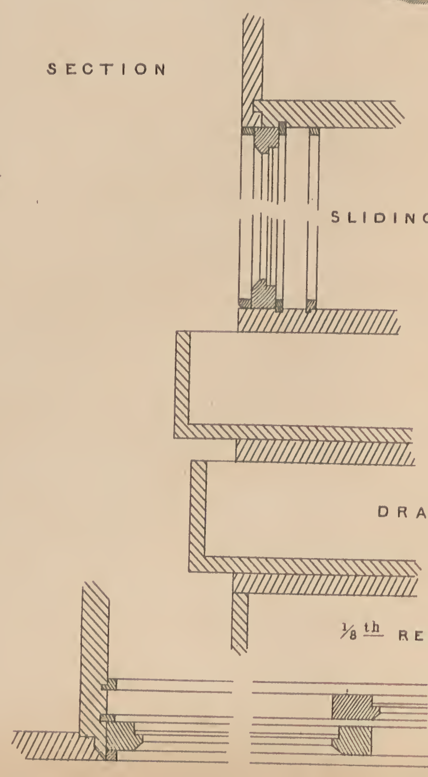


DETAIL—EXTERIOR



SECTION

PLAN



SLIDING SASHES AND DRAWERS.

1/8 th REAL SIZE

Designs for Shop Fittings.

Counters.

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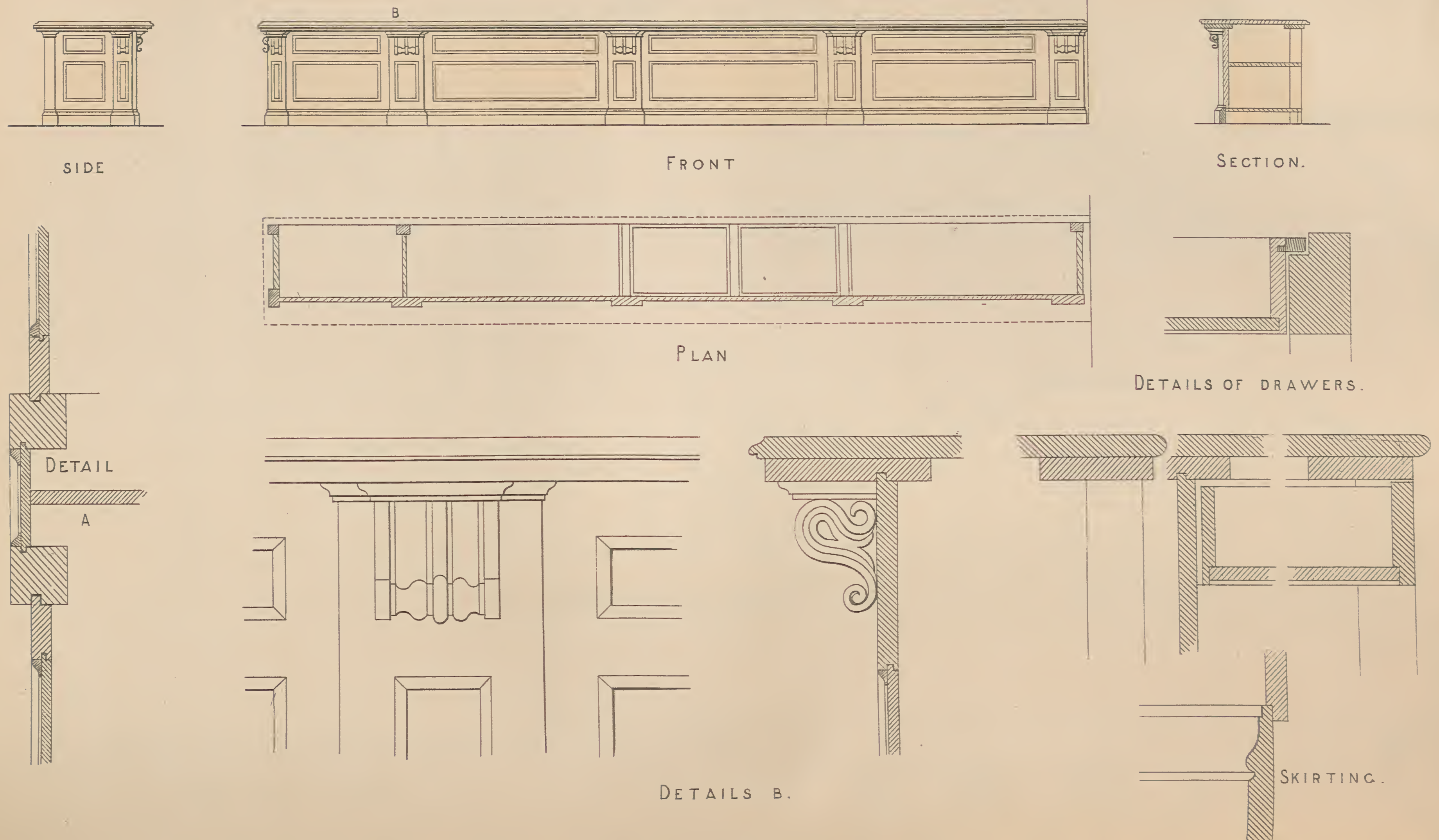
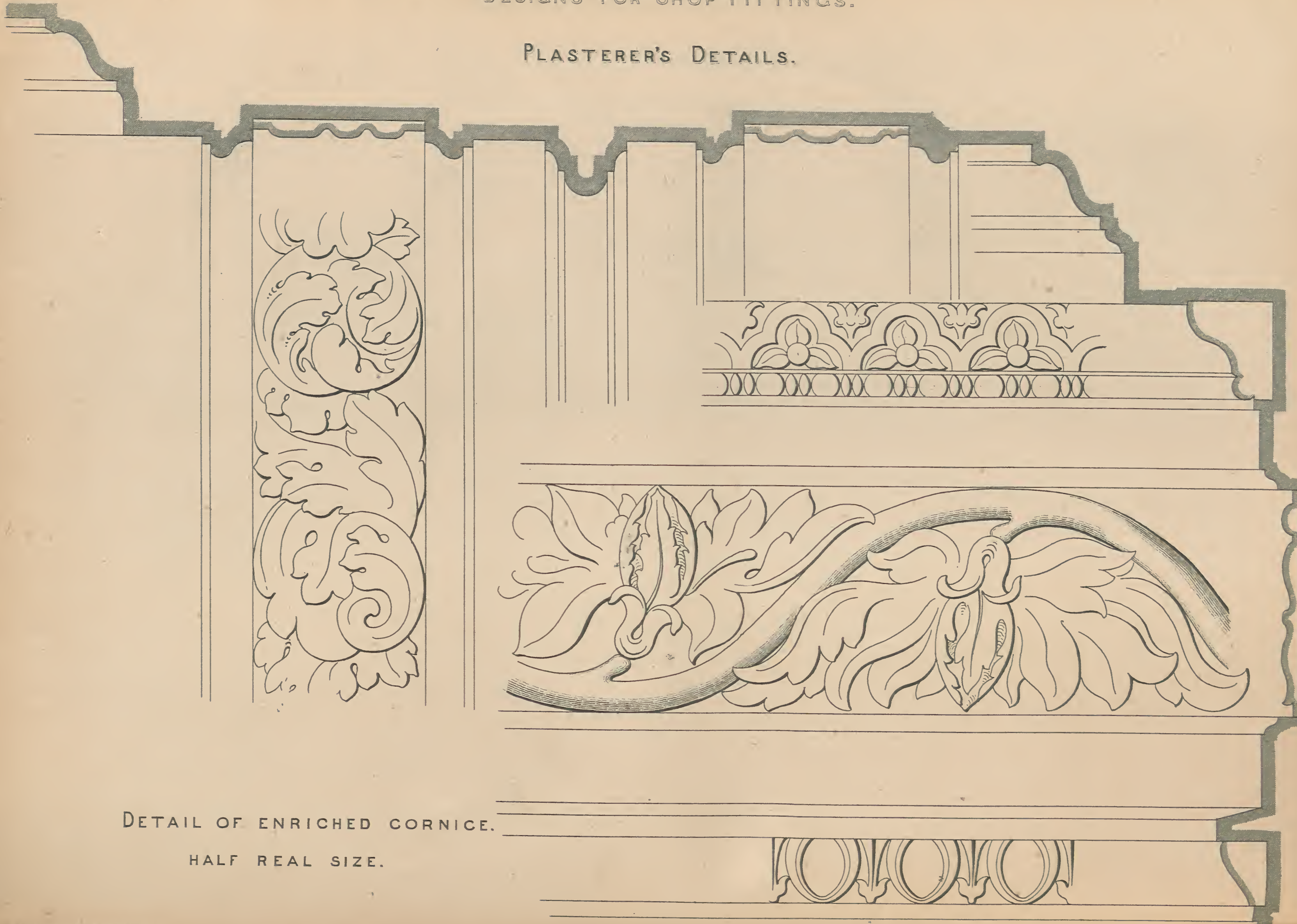


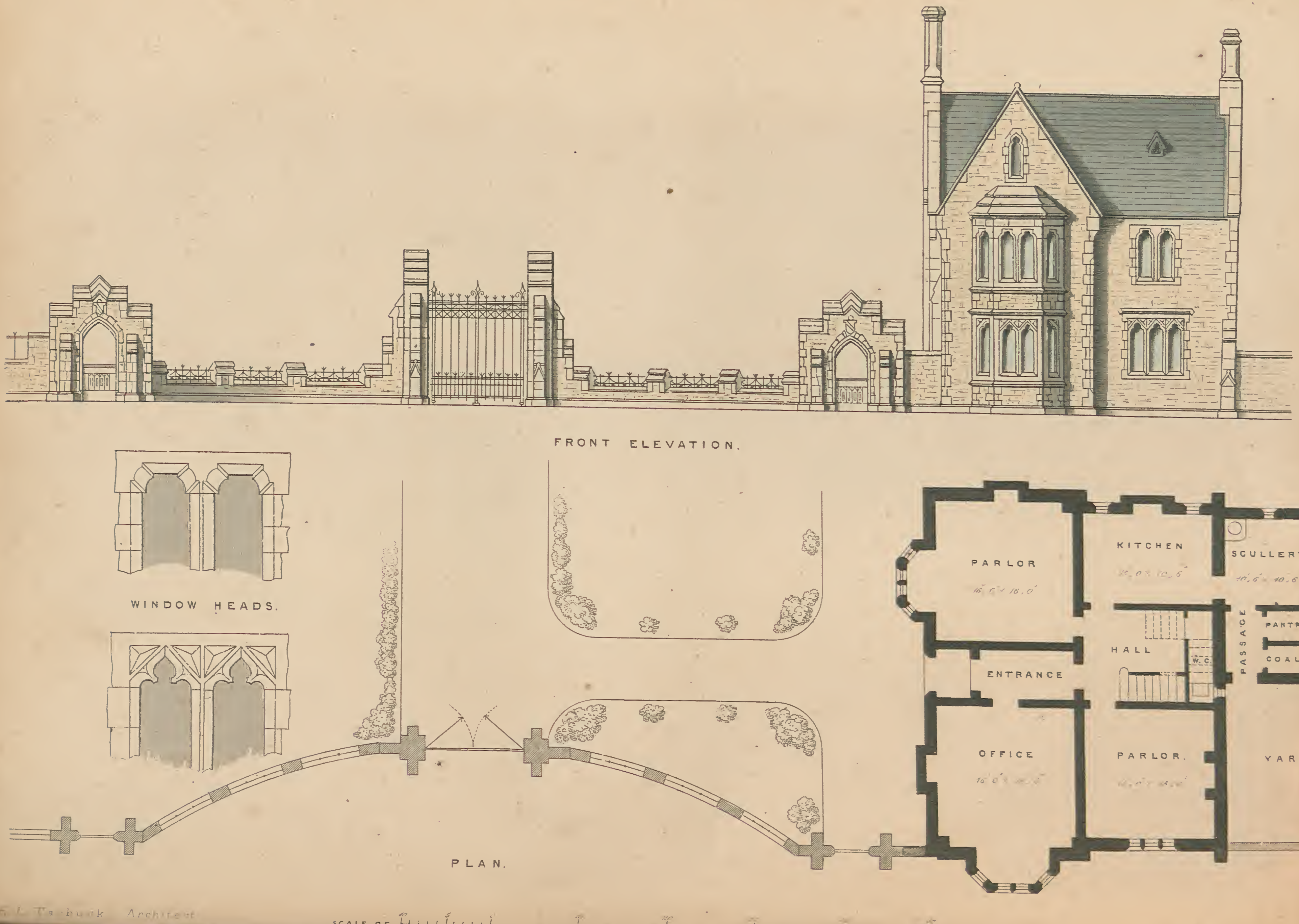
Plasterer's Details.



Detail of Enriched Cornice.

Half Real Size.

Designs for Cemetery Lodge and Entrance Gates

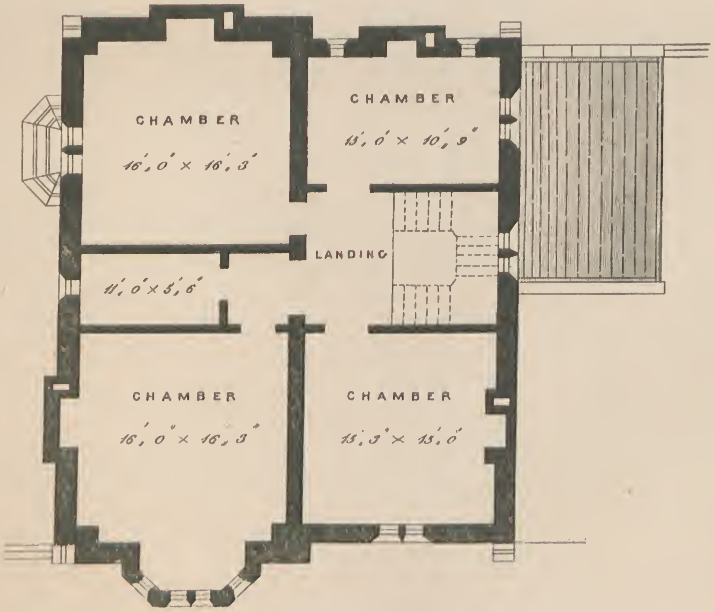


DESIGNS FOR CEMETERY LODGE.

SIDE ELEVATION

SIDE ELEVATION.

TRANSVERSE SECTION.

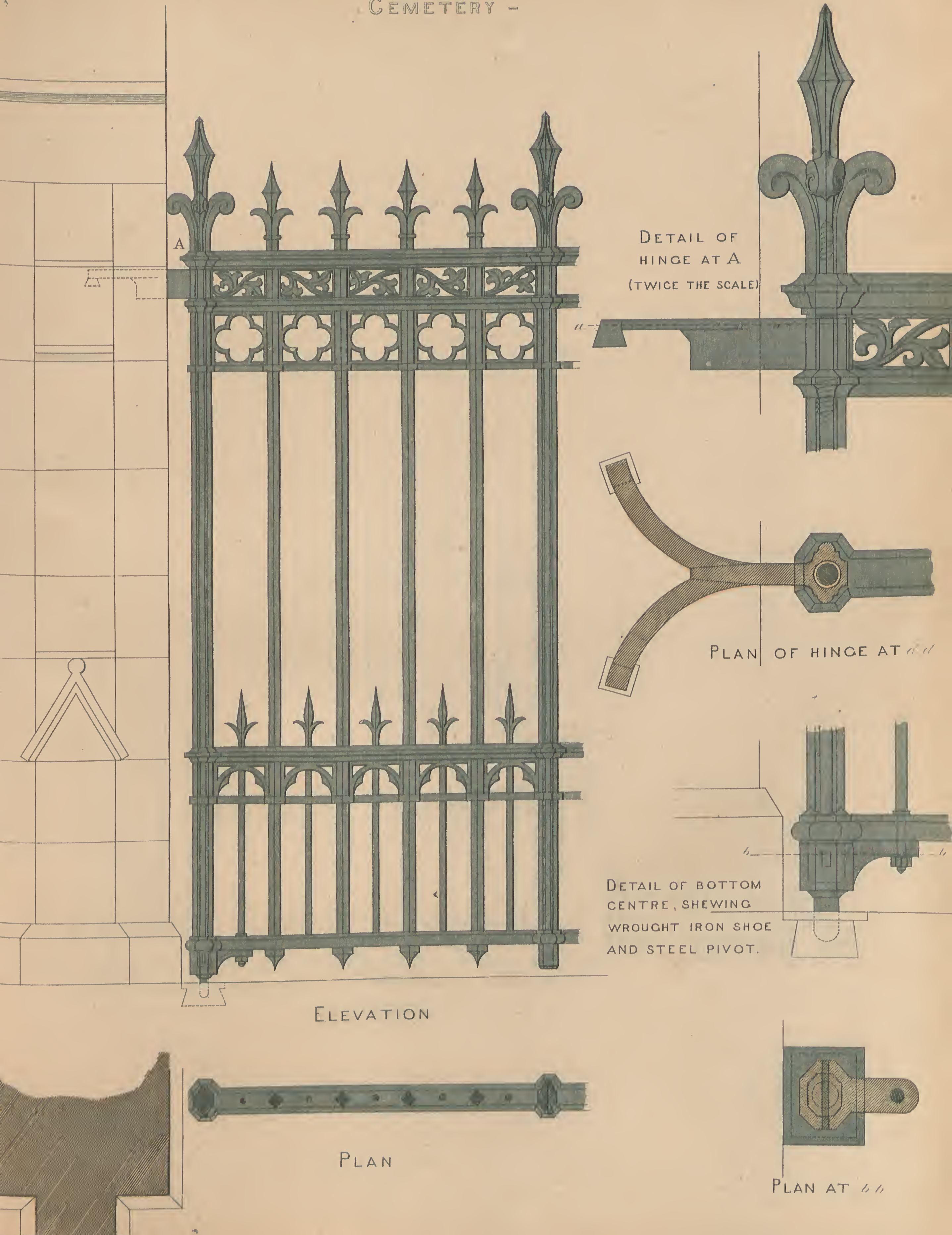


CHAMBER PLAN

SCALE OF 10 5 0 10 20 30 40 50 FEET

.L. Tarbuck. Architect. A. H. Payne sc.

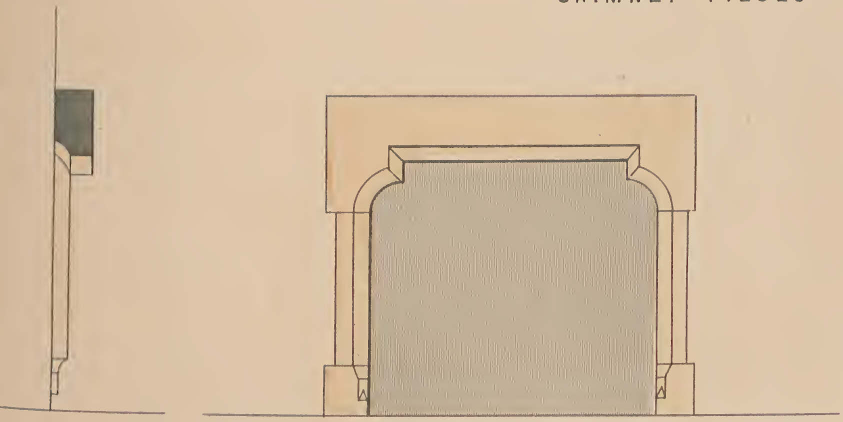
DETAILS OF GATES TO CEMETERY –



Designs for Cemetery Lodges

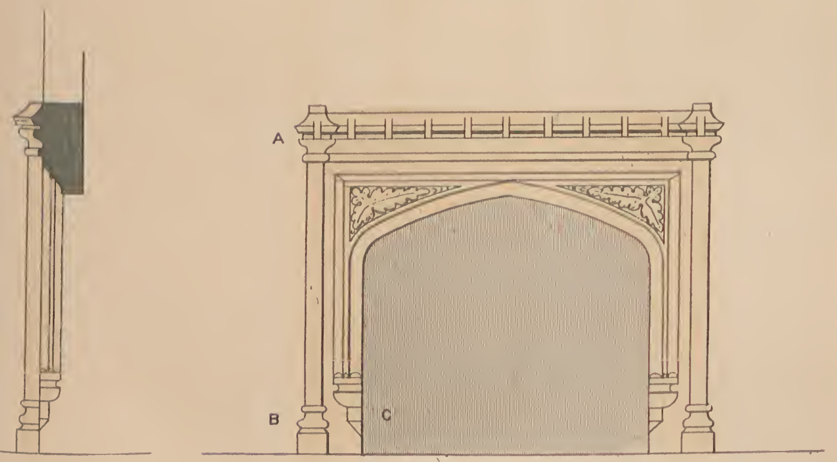
Mason's Details

Chimney Pieces—



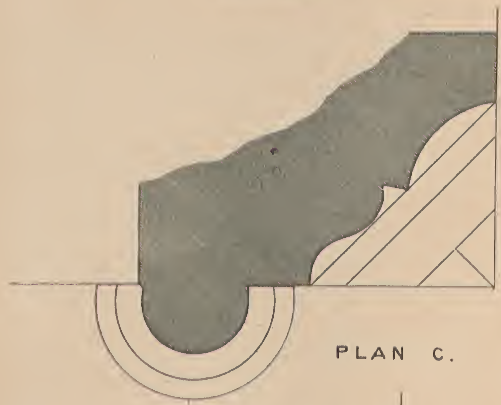
DETAIL A

N° 1

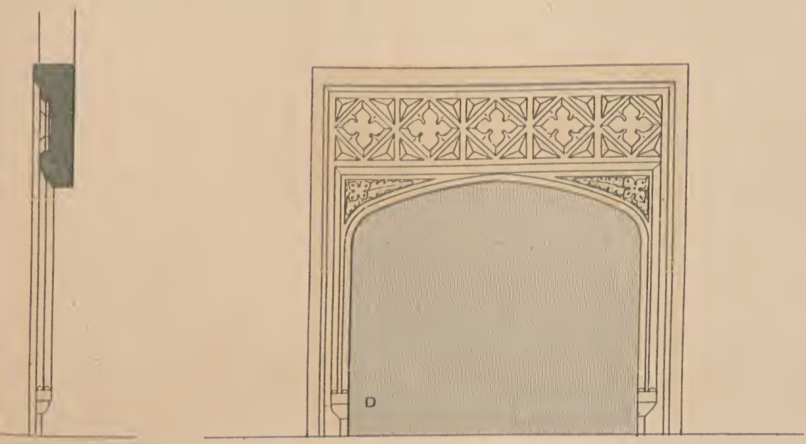


DETAIL B

N° 2



PLAN C.



PLAN D.

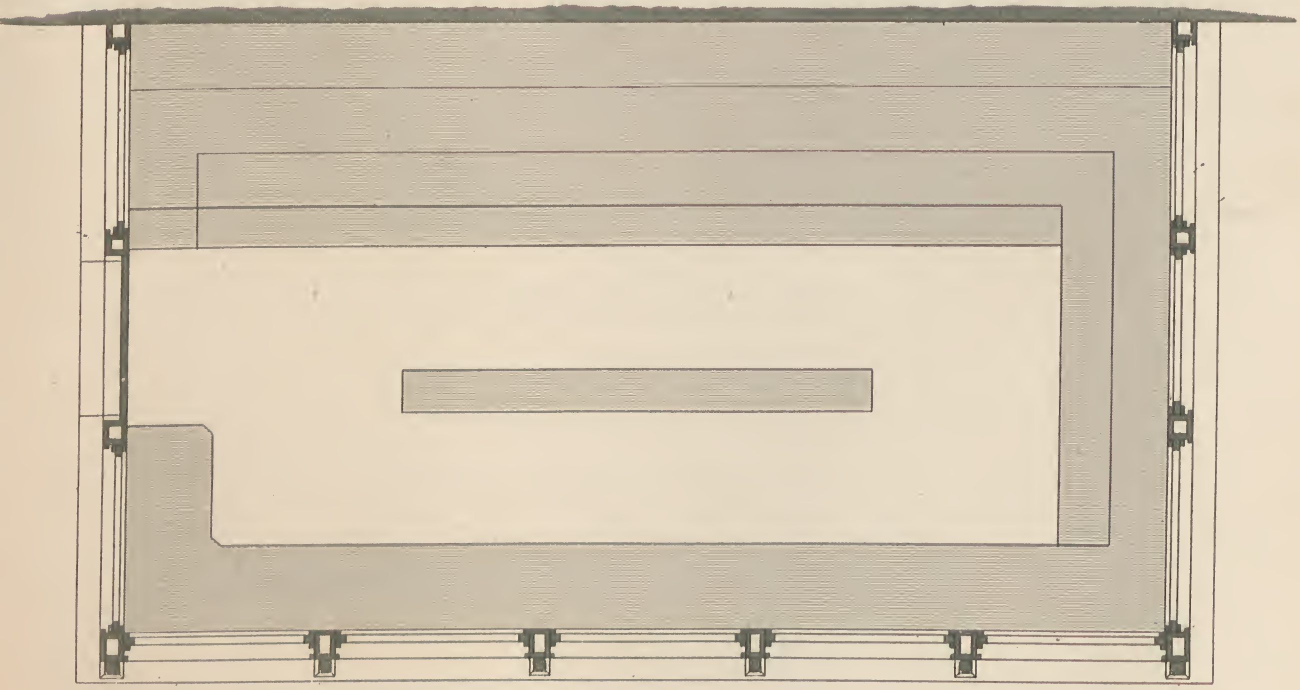
N° 3

SCALE OF 0 1 2 3 FEET

A H Payne

Design for a Greenhouse.

PRINCIPAL ELEVATION.



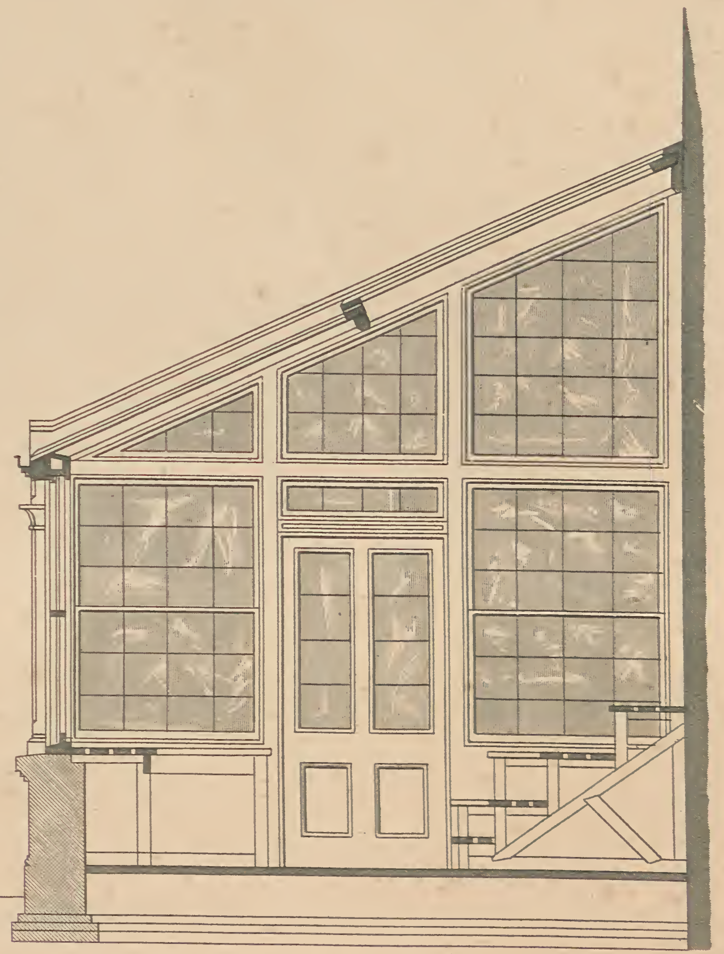
PLAN.

Scale of 

Feet.

Design for a Greenhouse.

SIDE ELEVATION.



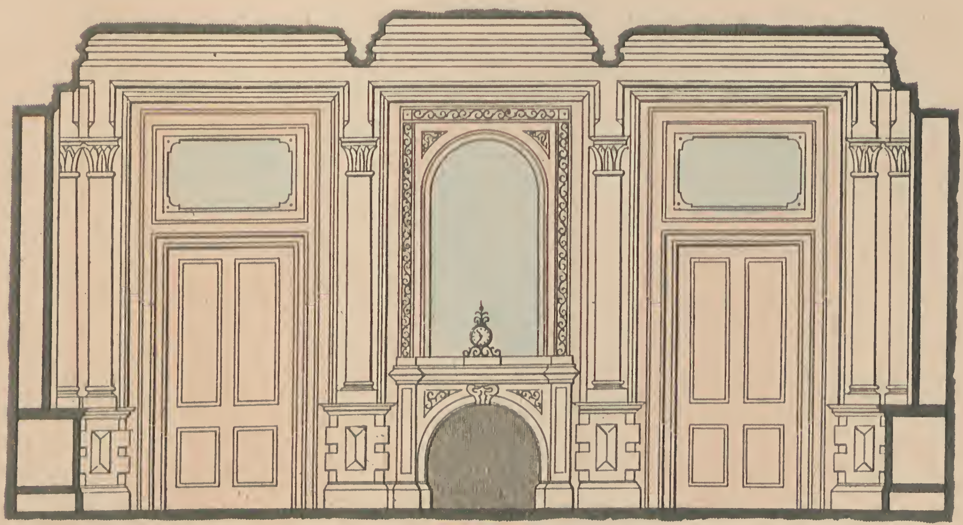
SECTION.

SCALE OF 10 5 0 10 FEET.

E. L. Tarbuck, Architect.

Designs for Shop Fittings

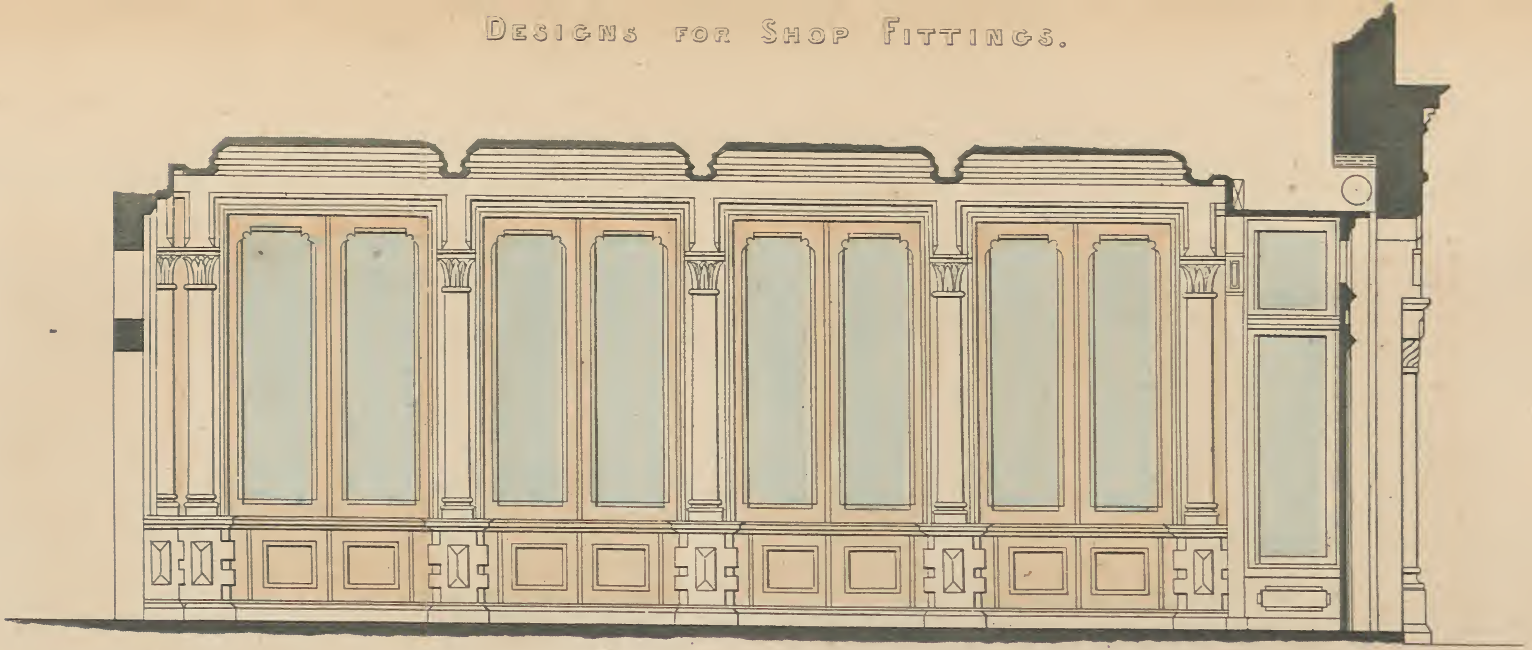
EXTERIOR ELEVATION



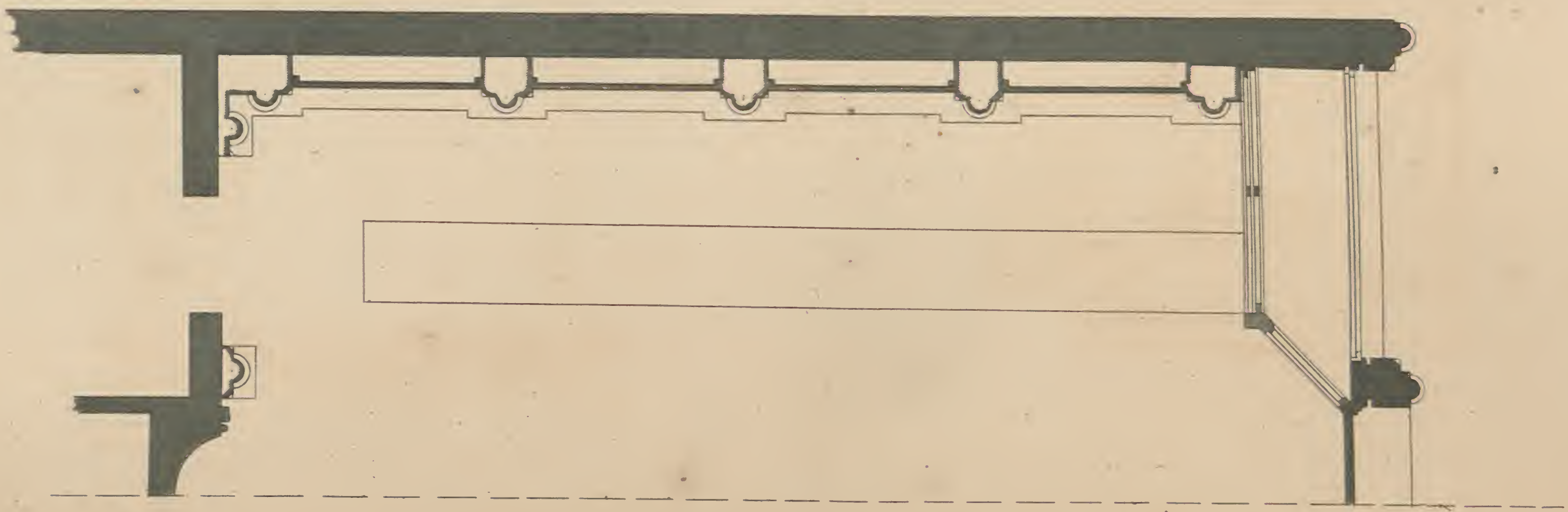
TRANSVERSE SECTION

SCALE OF 0 5 10 FEET

E.L. Tarbuck, Architect



LONGITUDINAL SECTION.

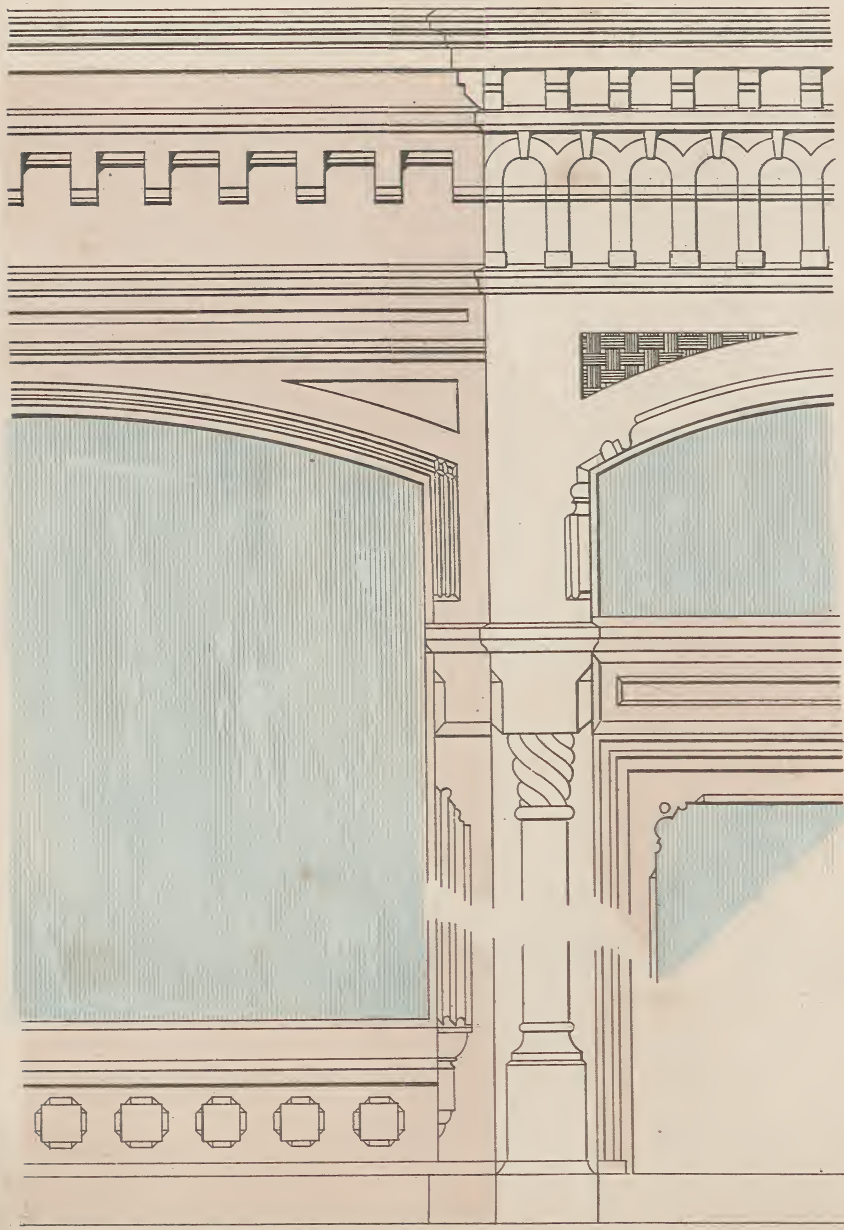


PLAN

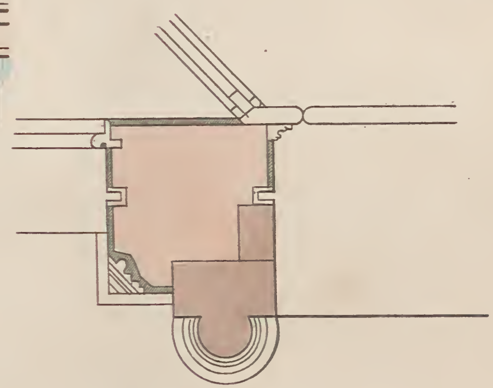
PLASTERER'S & JOINER'S DETAILS.

DETAILS OF

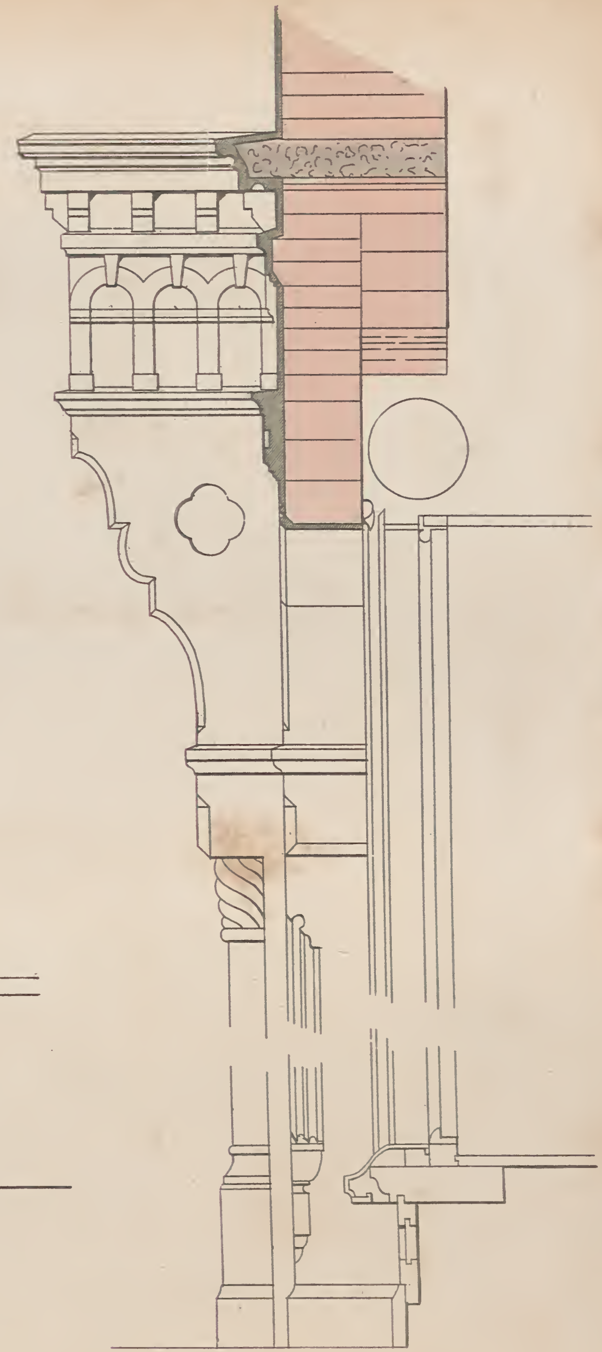
SHOP FRONT.



ELEVATION



PLAN



SECTION

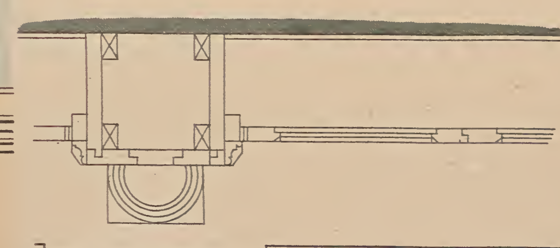
Designs for Shop Fittings.

Joiner's Details.

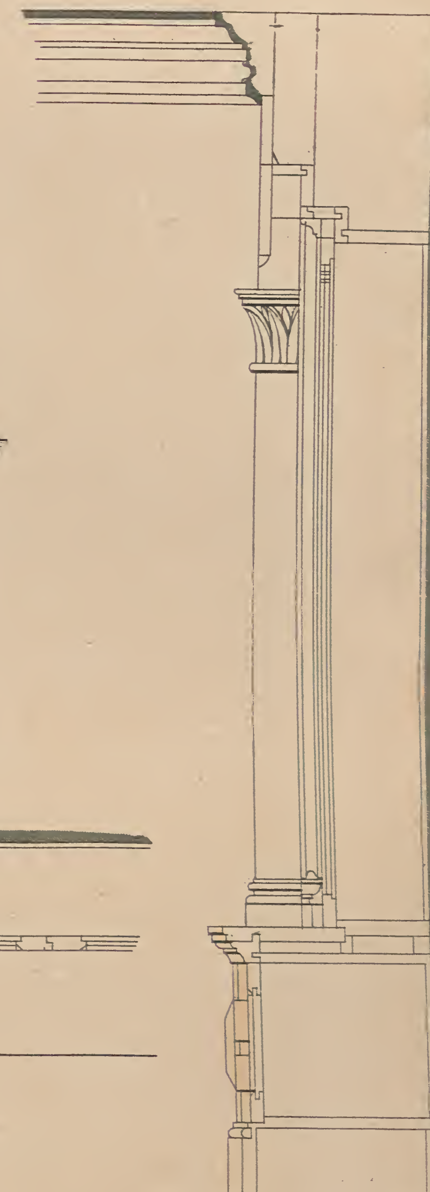
Details of Cases.

Elevation.

Scale of Feet.

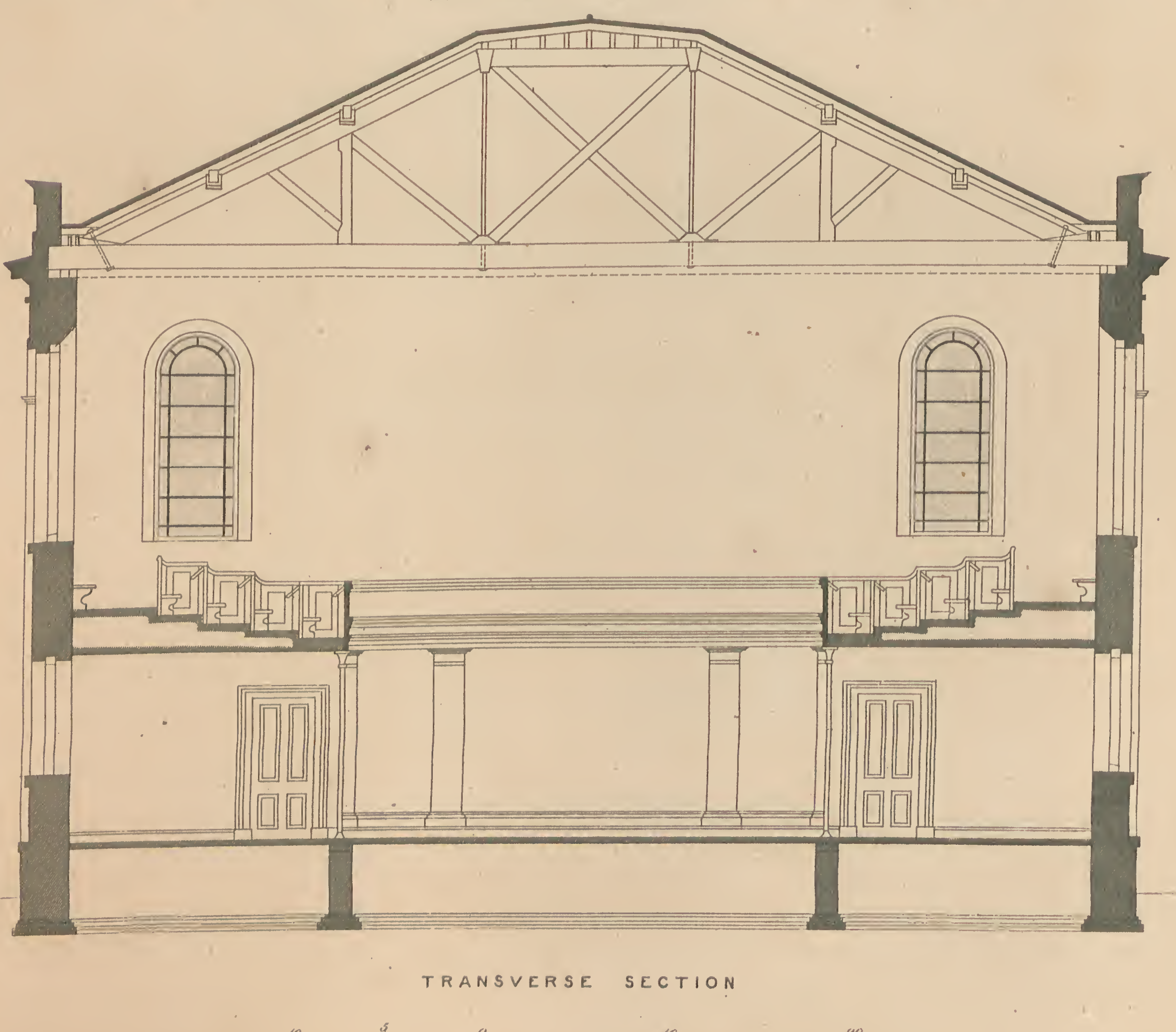


Plan.



Section.

PRINCIPAL ELEVATION



TRANSVERSE SECTION

SCALE OF 10 5 0 10 20 FEET.

E. L. Tarbuck Architect A. E. Payne sc.

Design for a Chapel.

LONGITUDINAL SECTION

SIDE ELEVATION

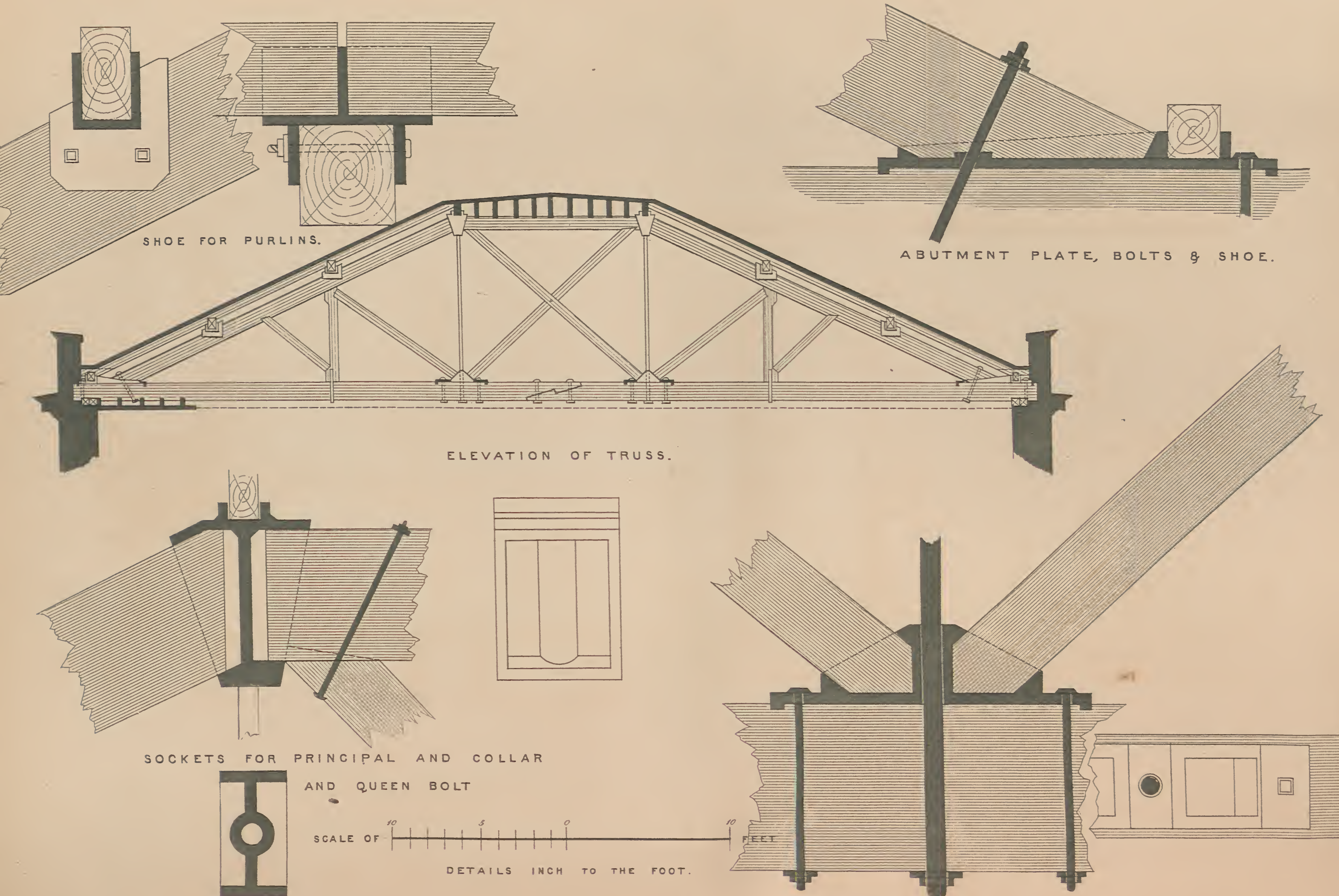
SCALE OF 10 5 0 10 20 FEET.

E. L. Tarbuck. Architect.

A. H. Payne sc

DESIGN FOR A CHAPEL.

DETAILS OF ROOF.



F. I. Tarbuck, Architect. A.H. Payne, sc.

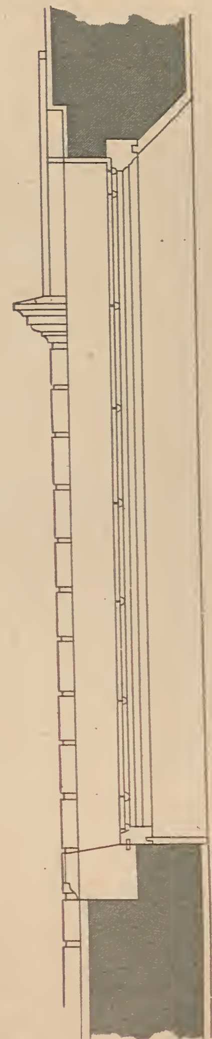
DESIGN FOR A CHAPEL

WINDOW AND DOOR.

SCALE OF 1 2 3 4 5 10 FEET

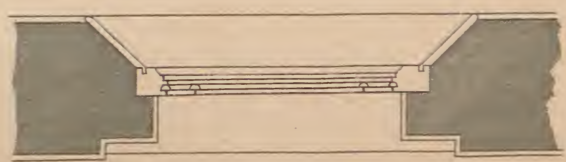
DETAILS 1/4 & 1/2 REAL SIZE.

ELEVATION

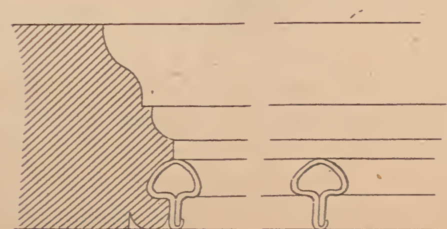


SECTION

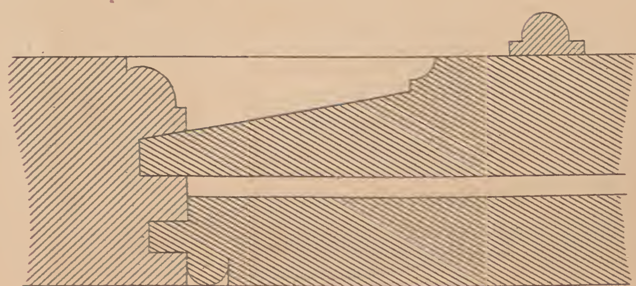
ELEVATION



PLAN



DETAIL OF WINDOW



DETAIL OF PANEL

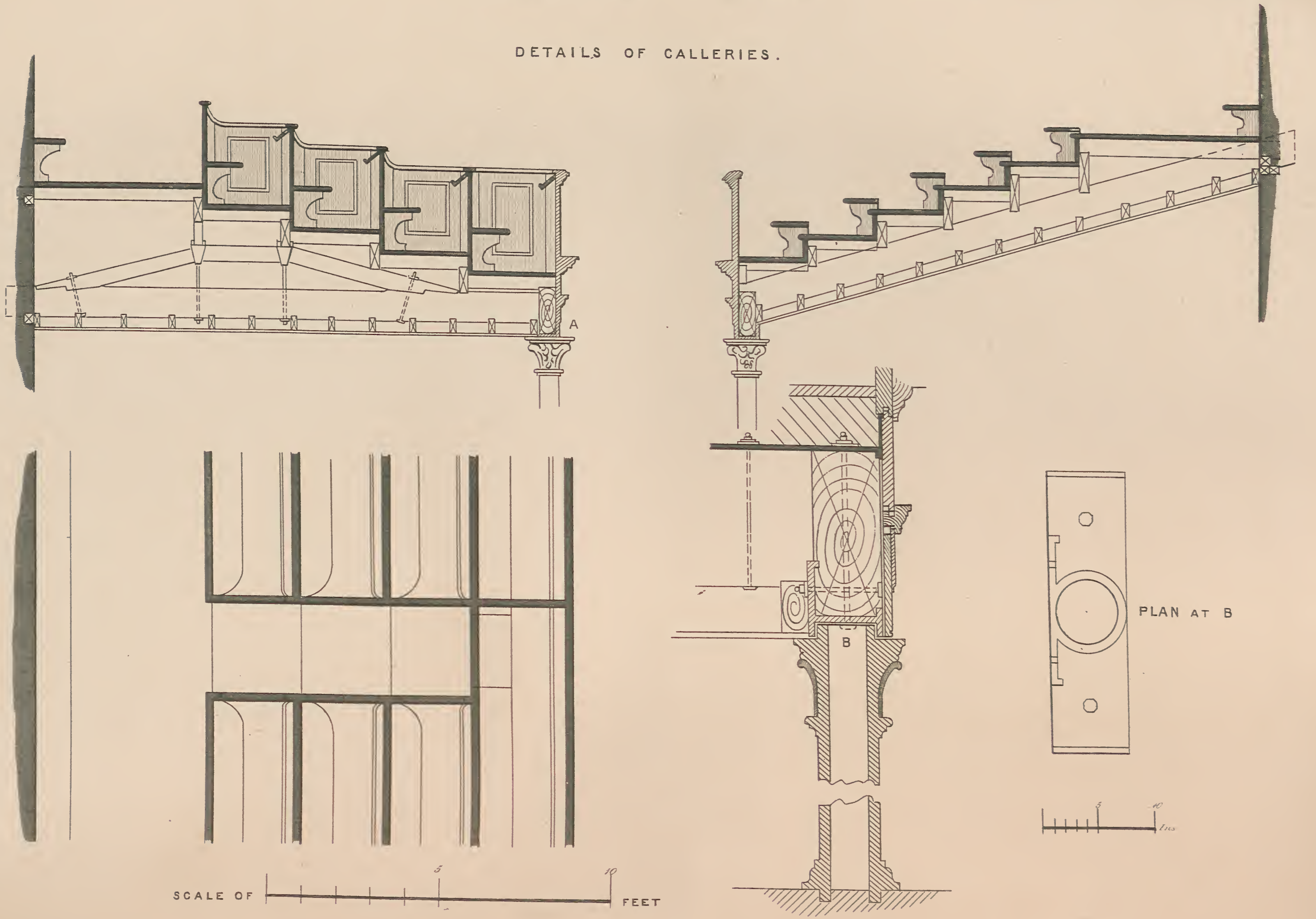
E. L. Tarbuck Archite.

A. H. Payne sc.

Plate 35

Design for a Chapel

DETAILS OF CALLERIES.



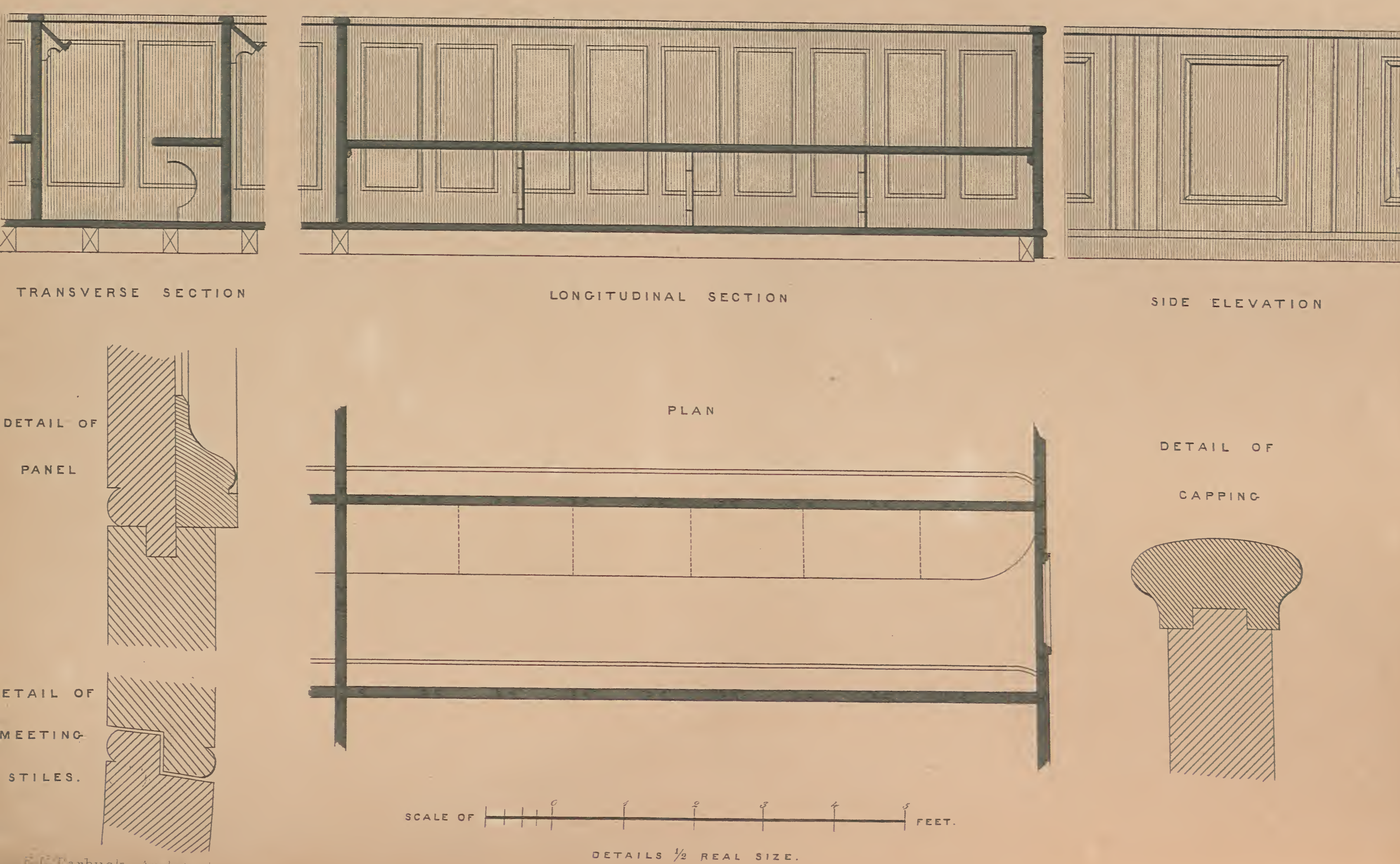
E. L. Tarbuck. Architect.

A. H. Payne sc.

Design for a Chapel

Joiner's Details

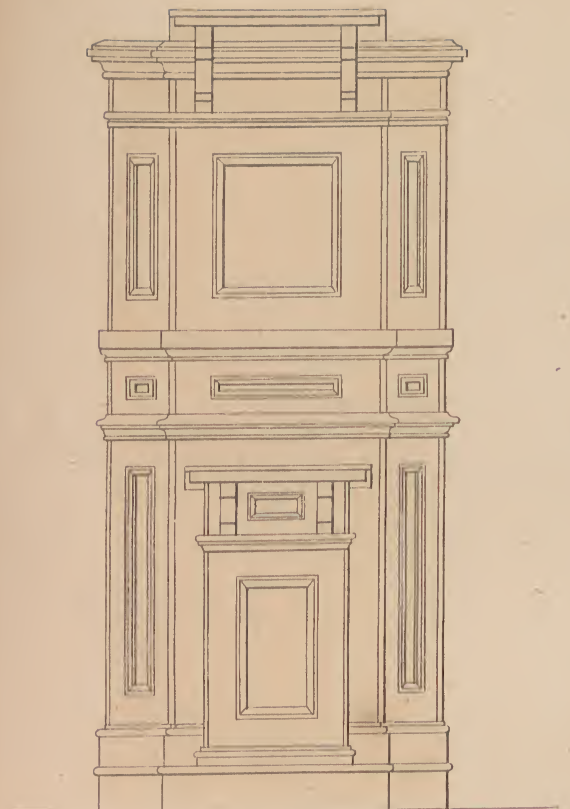
Pews.



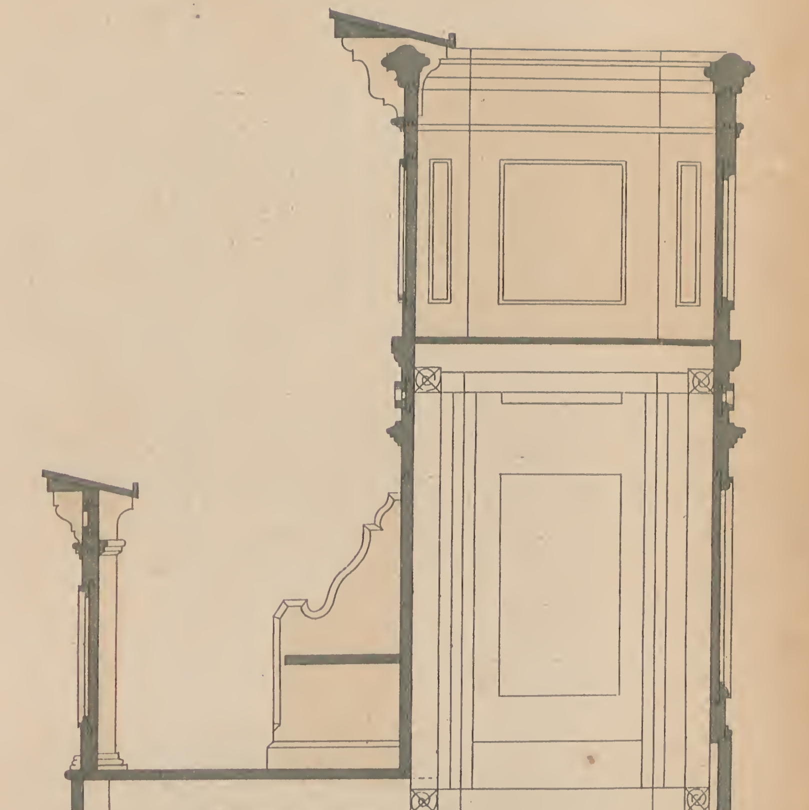
DESIGN FOR A CHAPEL.

JOINER'S DETAILS.

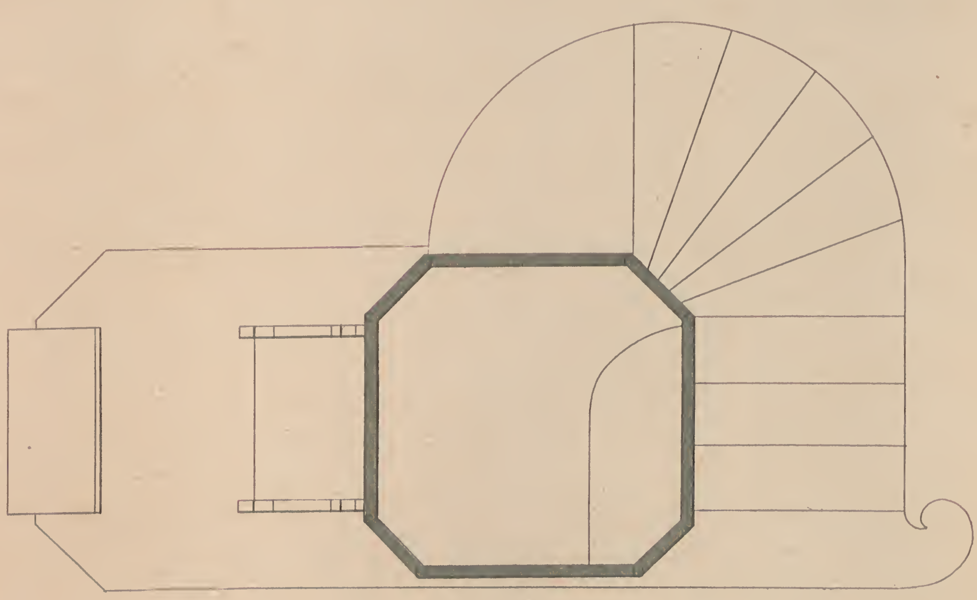
PULPIT.



ELEVATION



SECTION

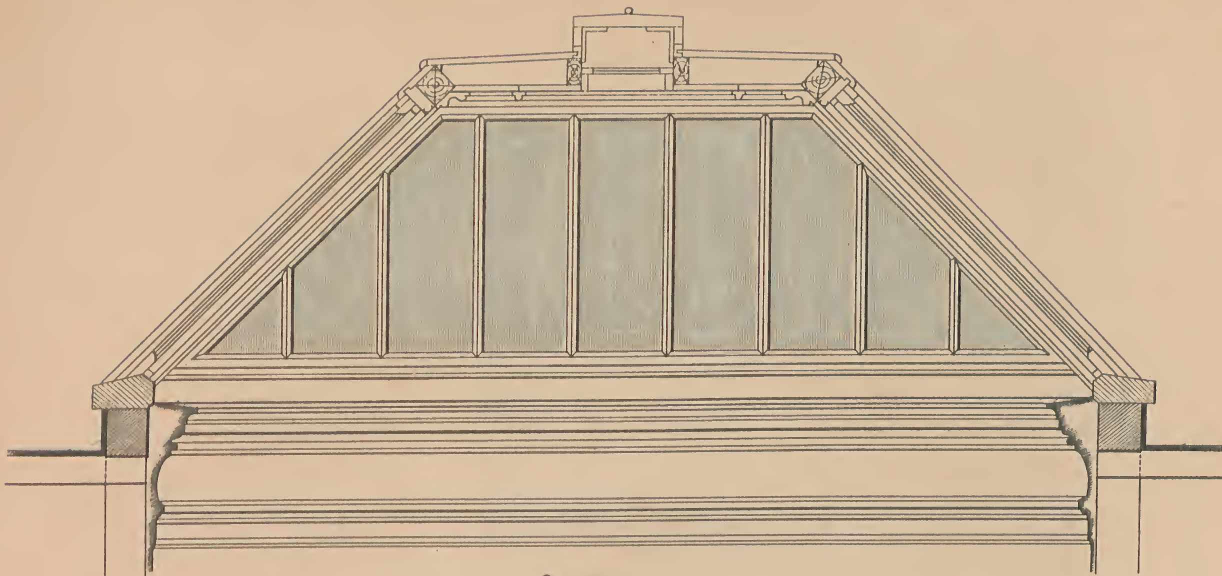


PLAN

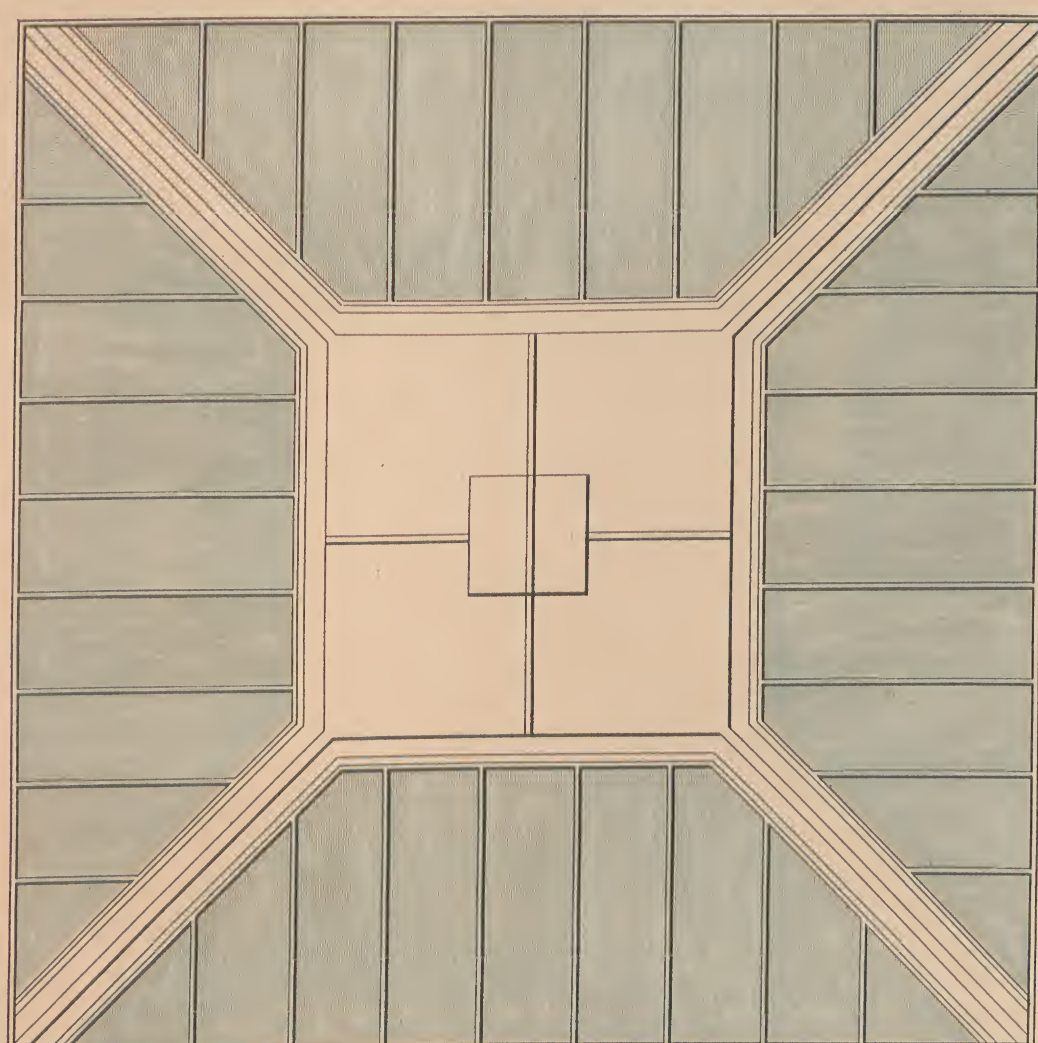
SCALE OF

FEET

Design for square skylight.



Section.

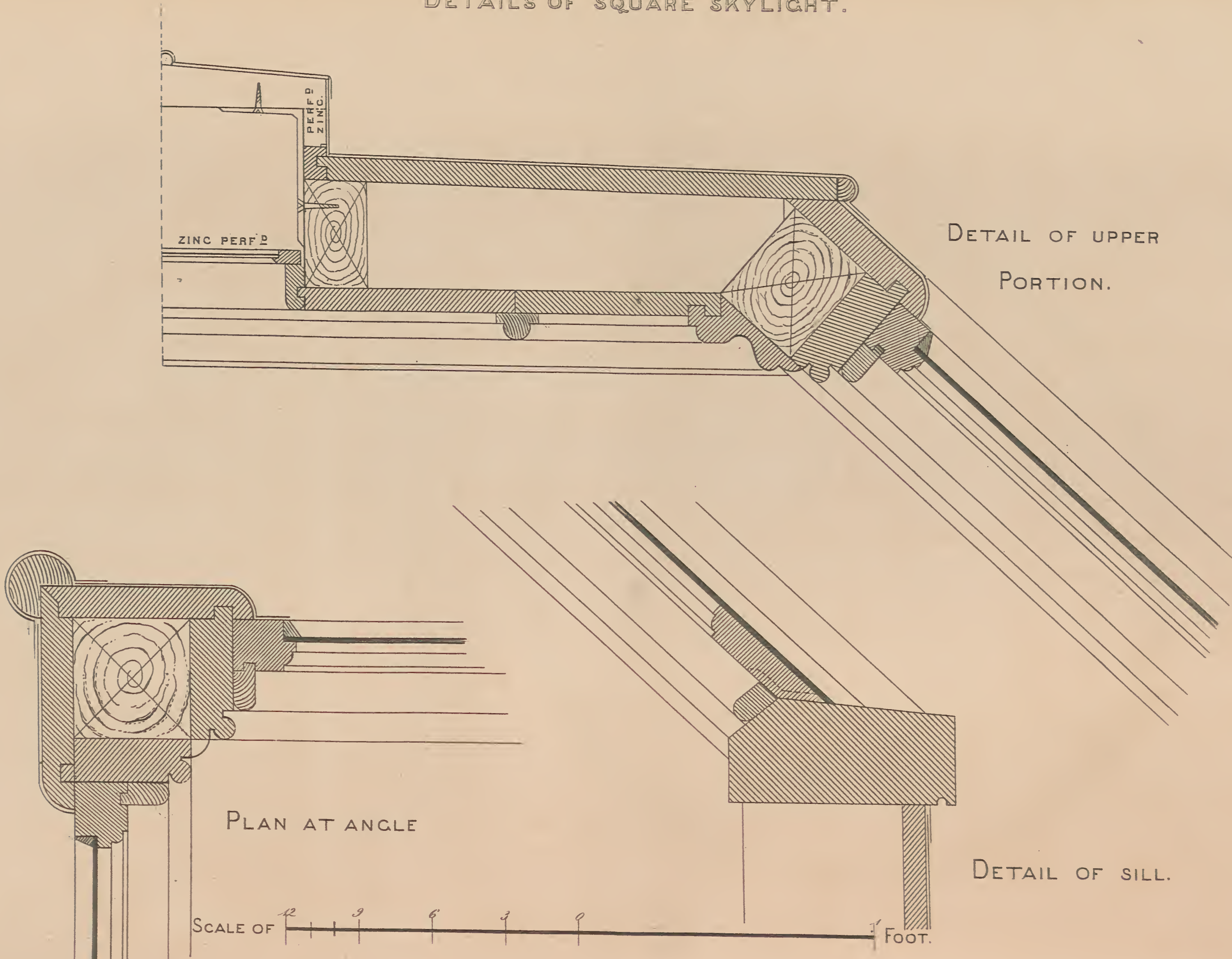


Plan.

Scale of 0 1 2 3 4 5 Feet.

J. Tarbuck, Architect. A. H. Payne, sc.

Details of square skylight.



Detail of upper Portion.

Plan at angle

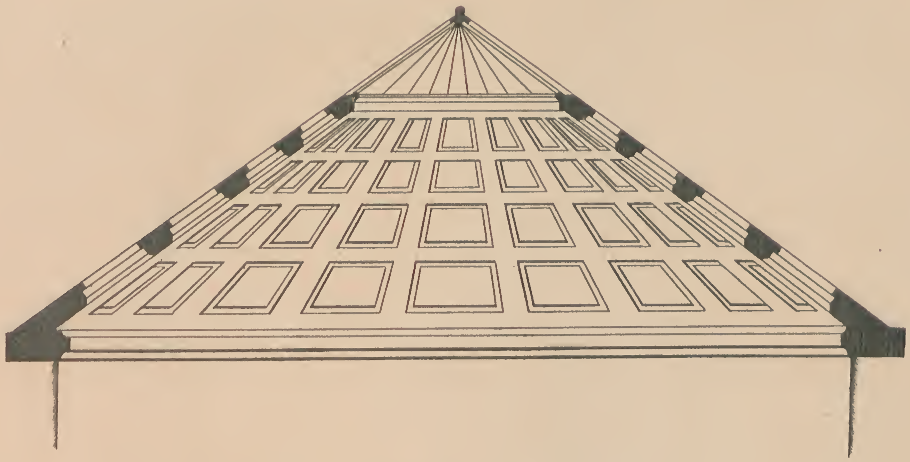
Detail of sill.

Scale of 1 Foot.

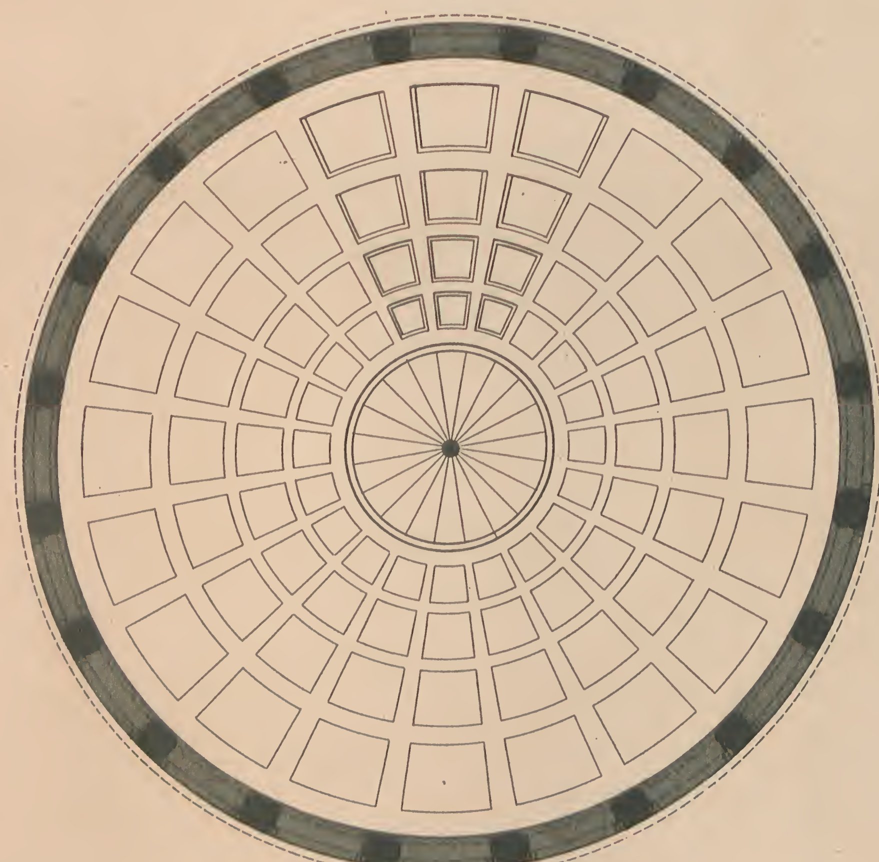
E. L. Tarbuck. Architect.

A. H. Payne

DESIGN FOR CIRCULAR SKYLIGHT.



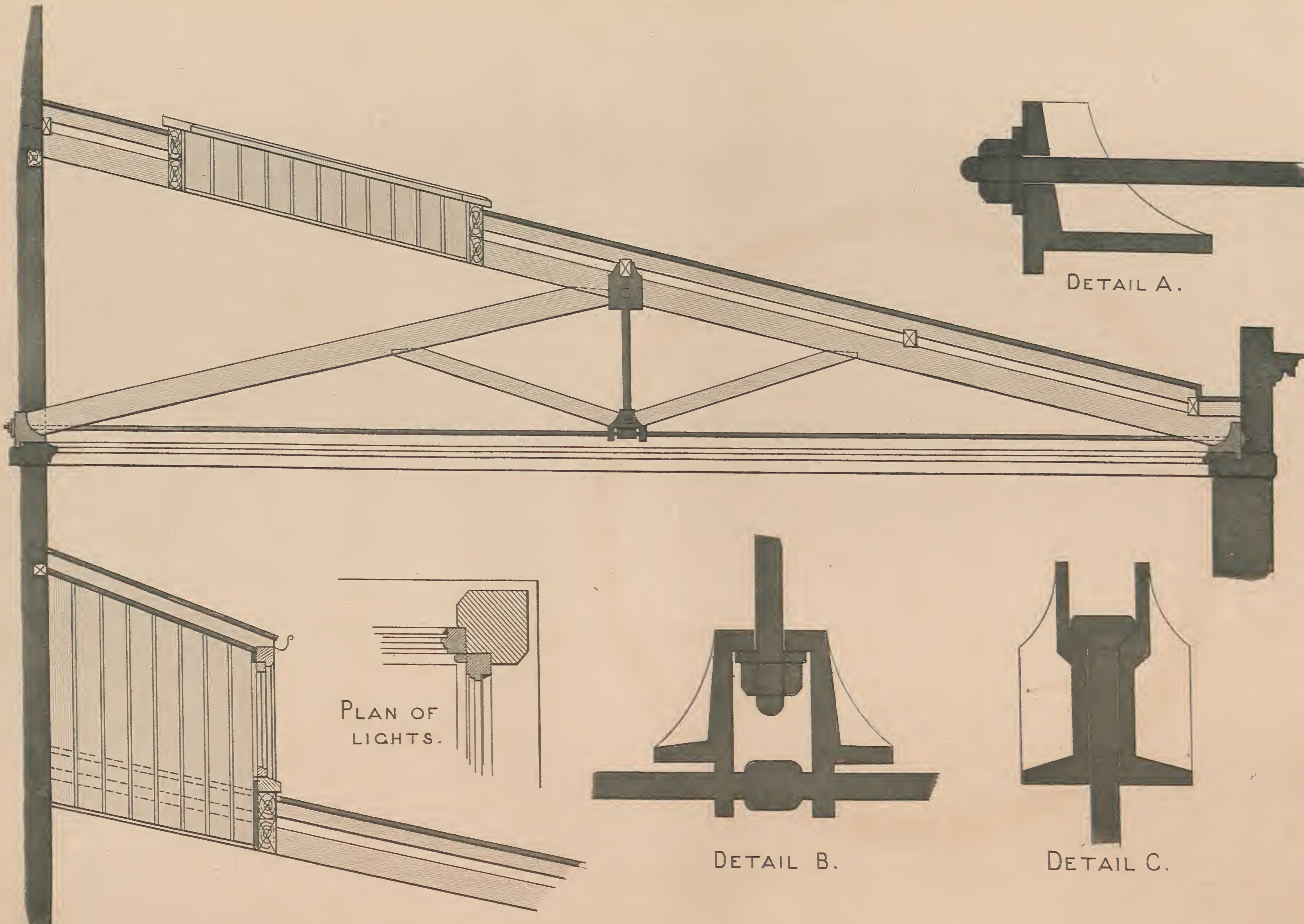
SECTION.



PLAN.

SCALE OF 10 5 0 10 FEET.

Details of Skylights.



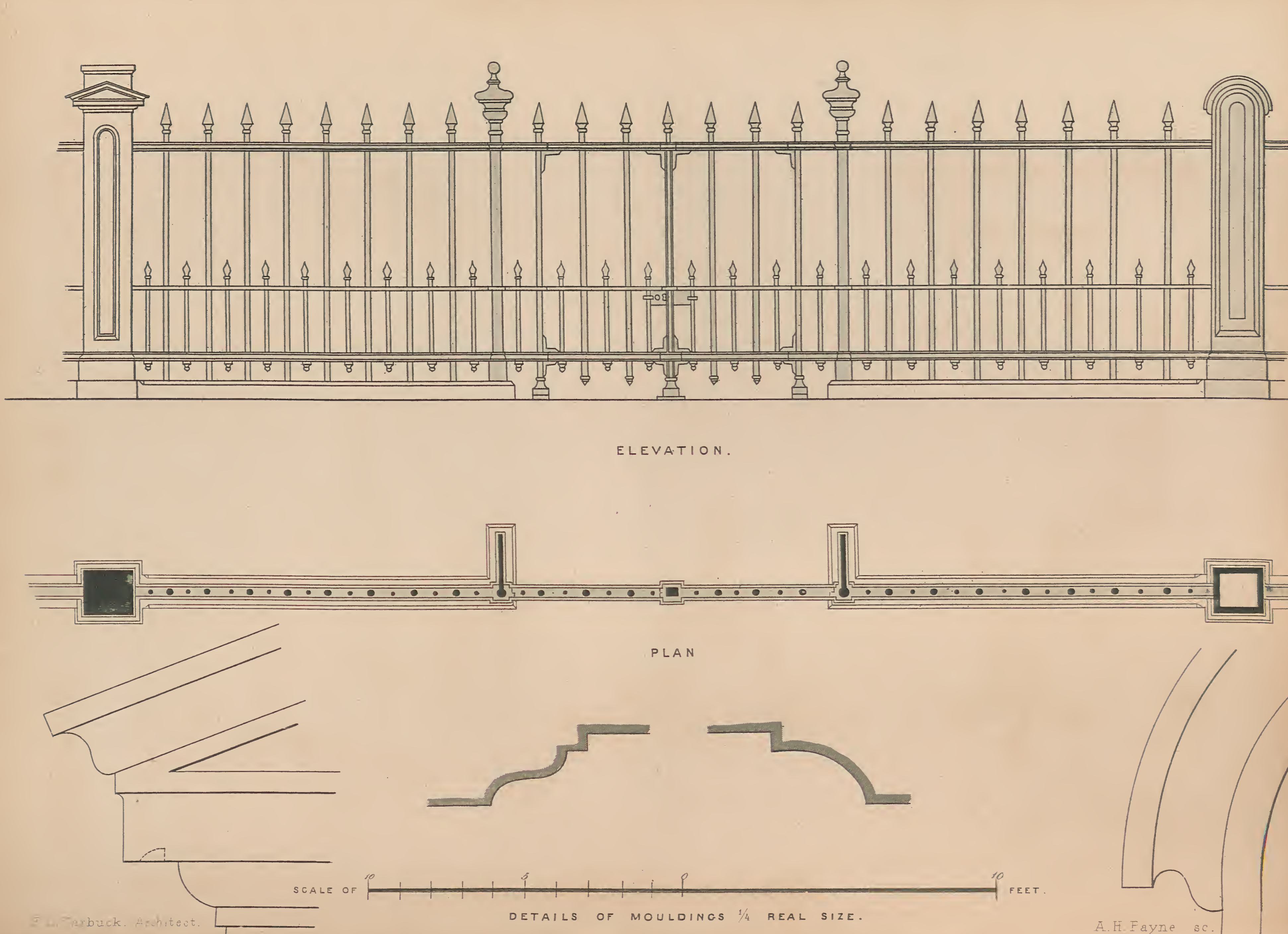
Scale of 10 5 0 10 Feet.

Details ⅛ real size.

arbuck. Architect.

A. H. Payne sc.

DESIGN FOR IRON RAILING.

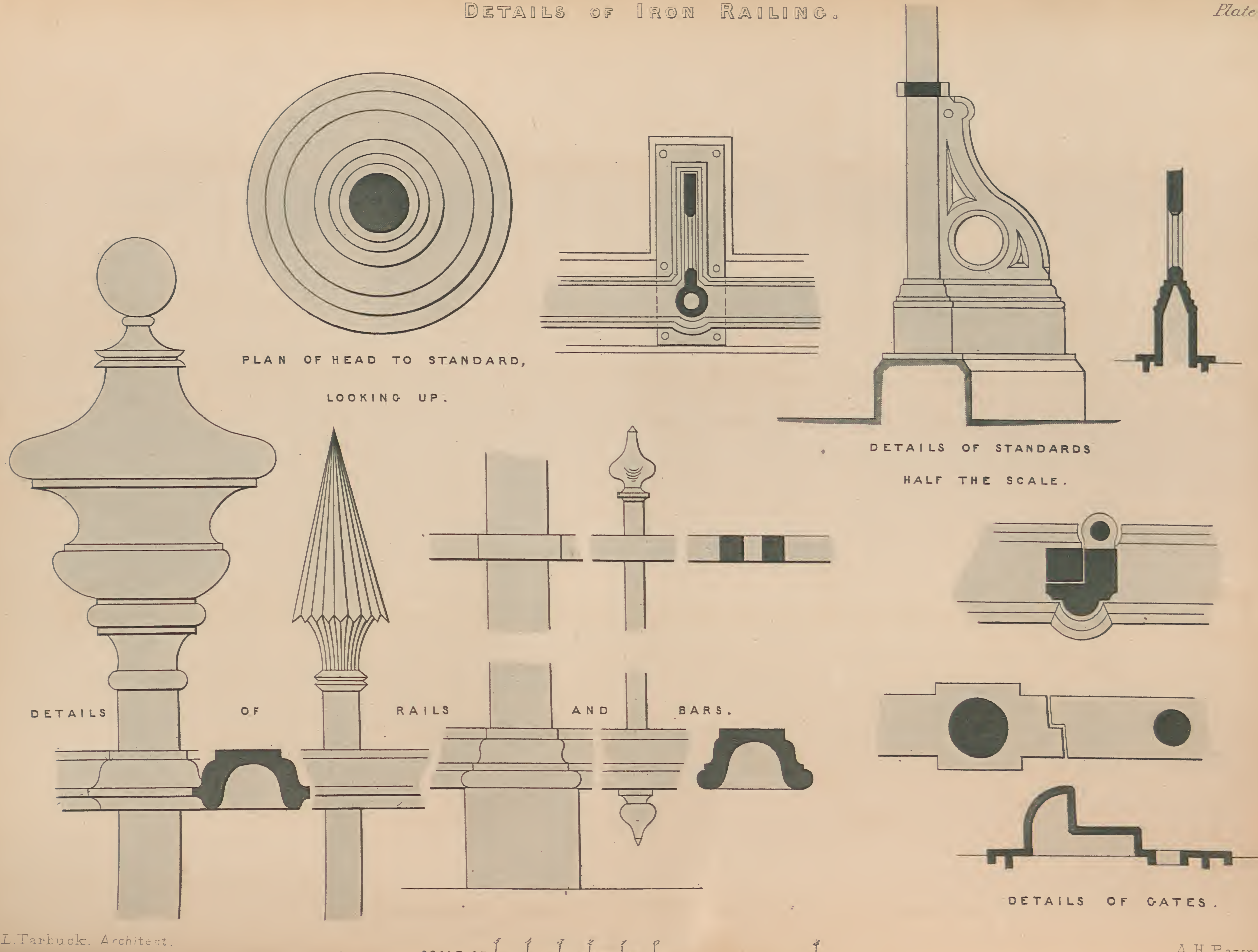


E. L. Tarbuck. Architect.

A. H. Payne sc.

DETAILS OF IRON RAILING.

Plate 43

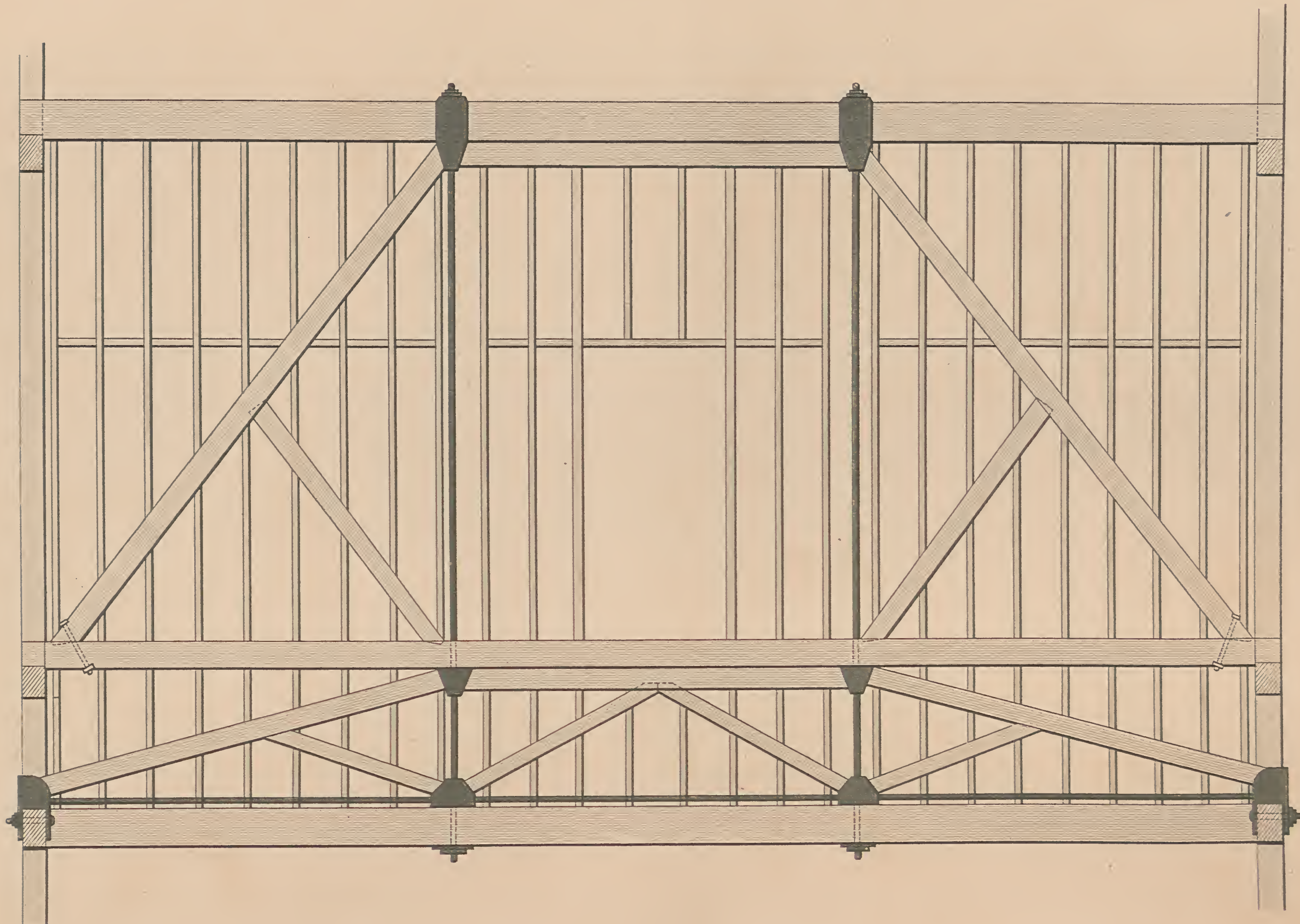


E. L. Tarbuck. Architect.

A. H. Payne

CARPENTER'S DETAILS.

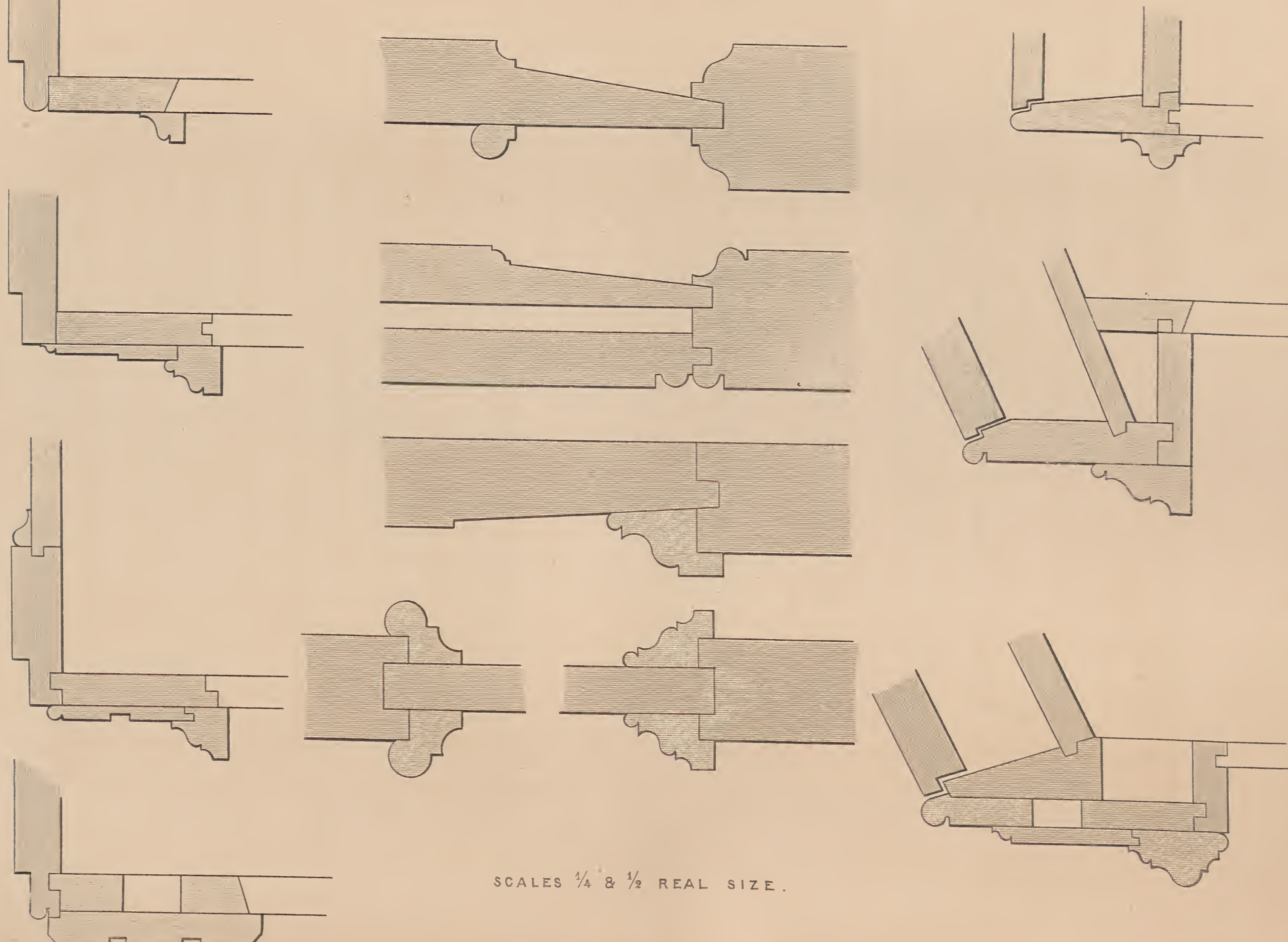
PARTITION.



JOINER'S DETAILS

Plate

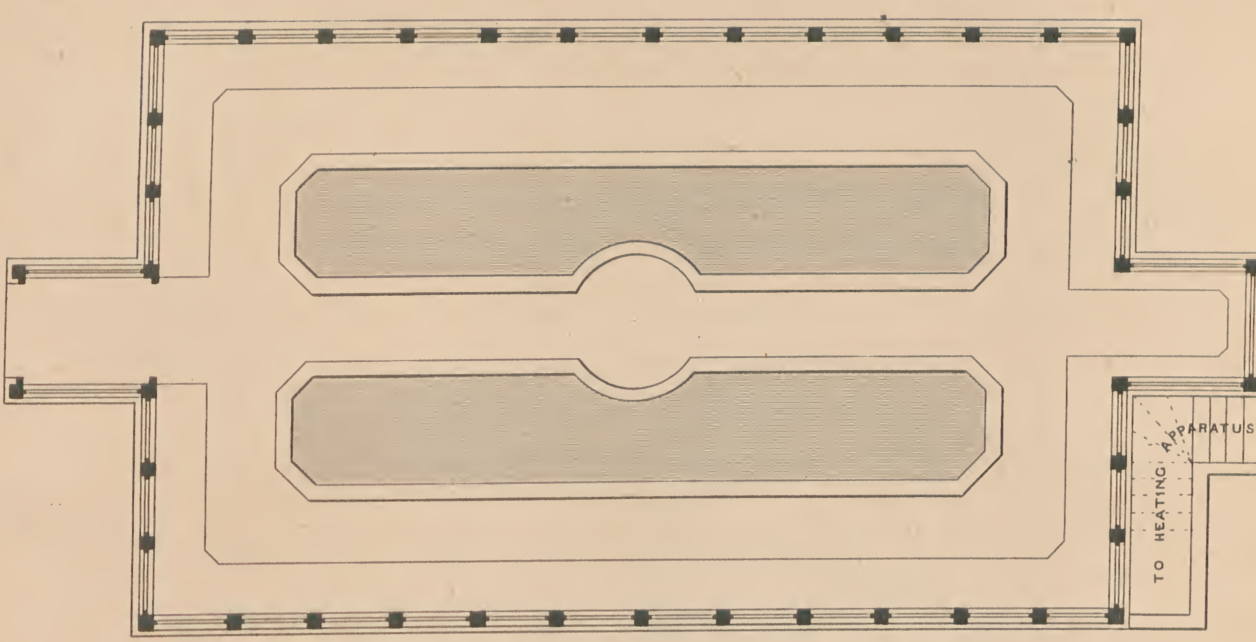
ARCHITRAVES TO DOORS AND WINDOWS.



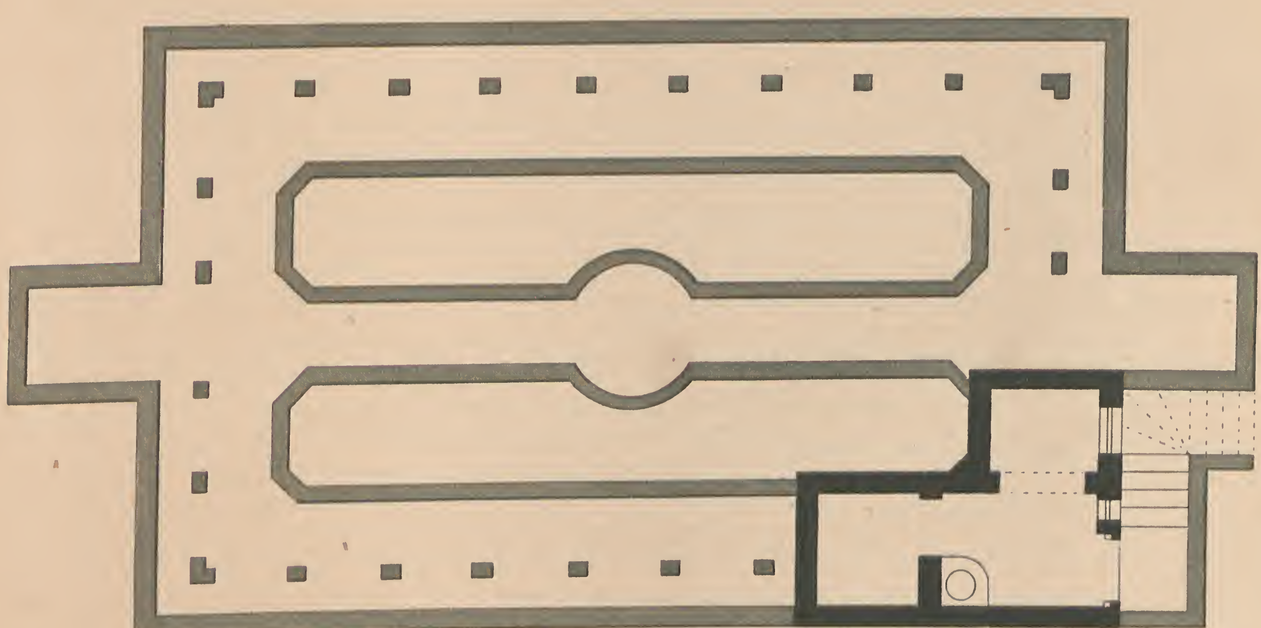
SCALES 1/4 & 1/2 REAL SIZE.

A. H. Payne

Design for a Conservatory.



Ground plan.



Basement plan.

Scale of 10 5 0 10 20 feet.

E. L. Tarbuck Architect

A. H. Payne sc.

DESIGN FOR A CONSERVATORY.

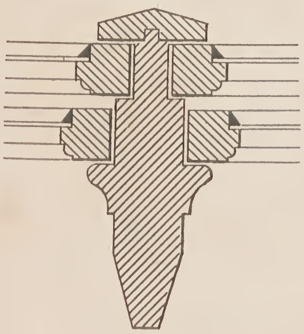


Fig. 1.

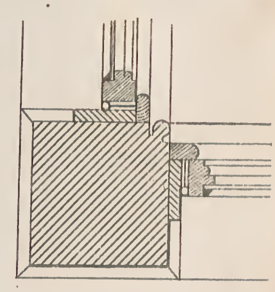
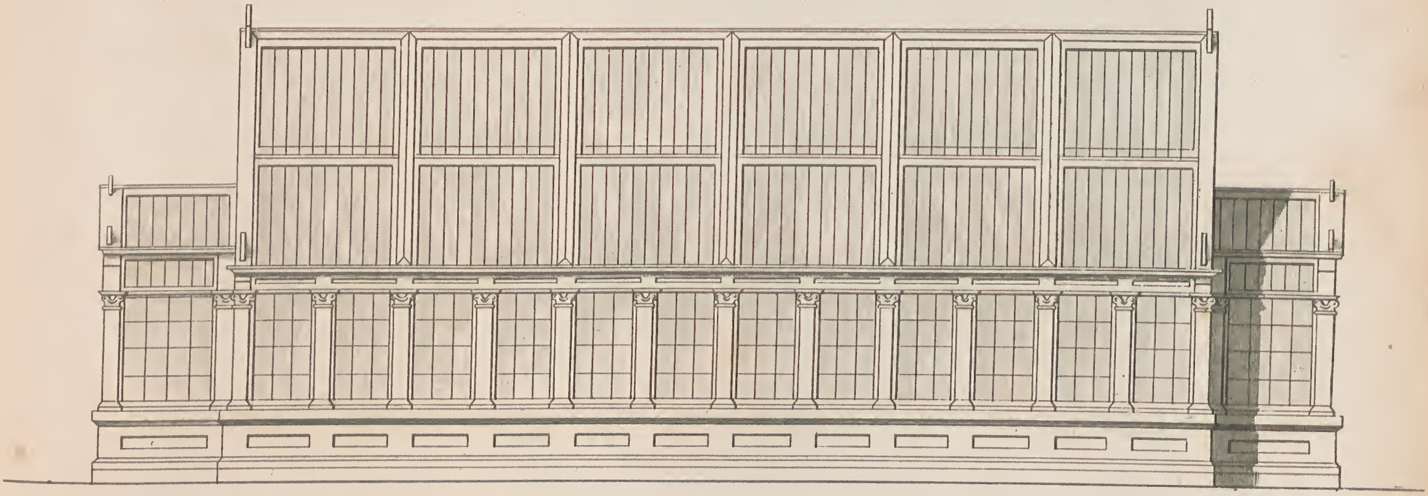


Fig. 2.

END—ELEVATION. TRANSVERSE SECTION.



SIDE—ELEVATION.

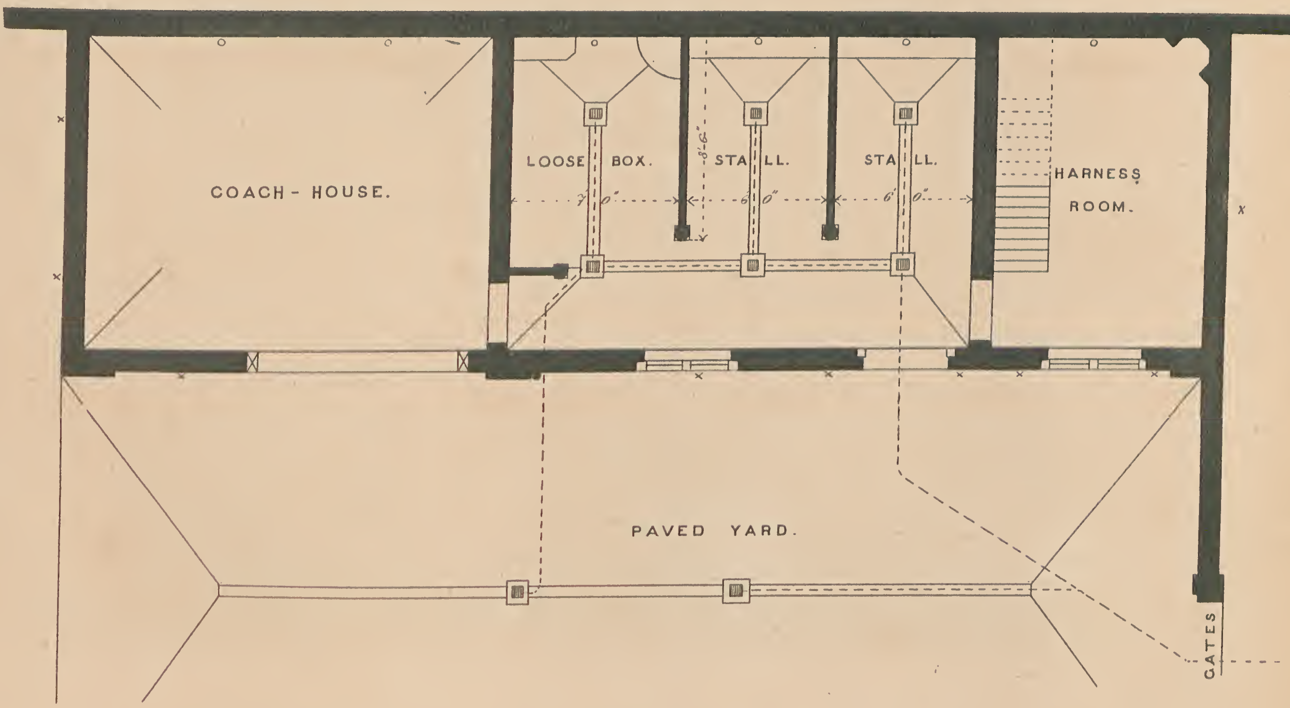
SCALE OF

FEET.

DETAILS 1/8th REAL SIZE.

E.L.Tarbuck, Architect.

Stable Fittings.



Stable, with two stalls, loose-box, coach-house, harness, bed-room and loft.

X. Air bricks 6 ins. above floor level

O. D° 3 " below ceiling D°

The dotted lines indicate drainage.

Scale of 10 5 0 10 Feet.

E. L. Tarbuck Architect

A. H. Payne sc.

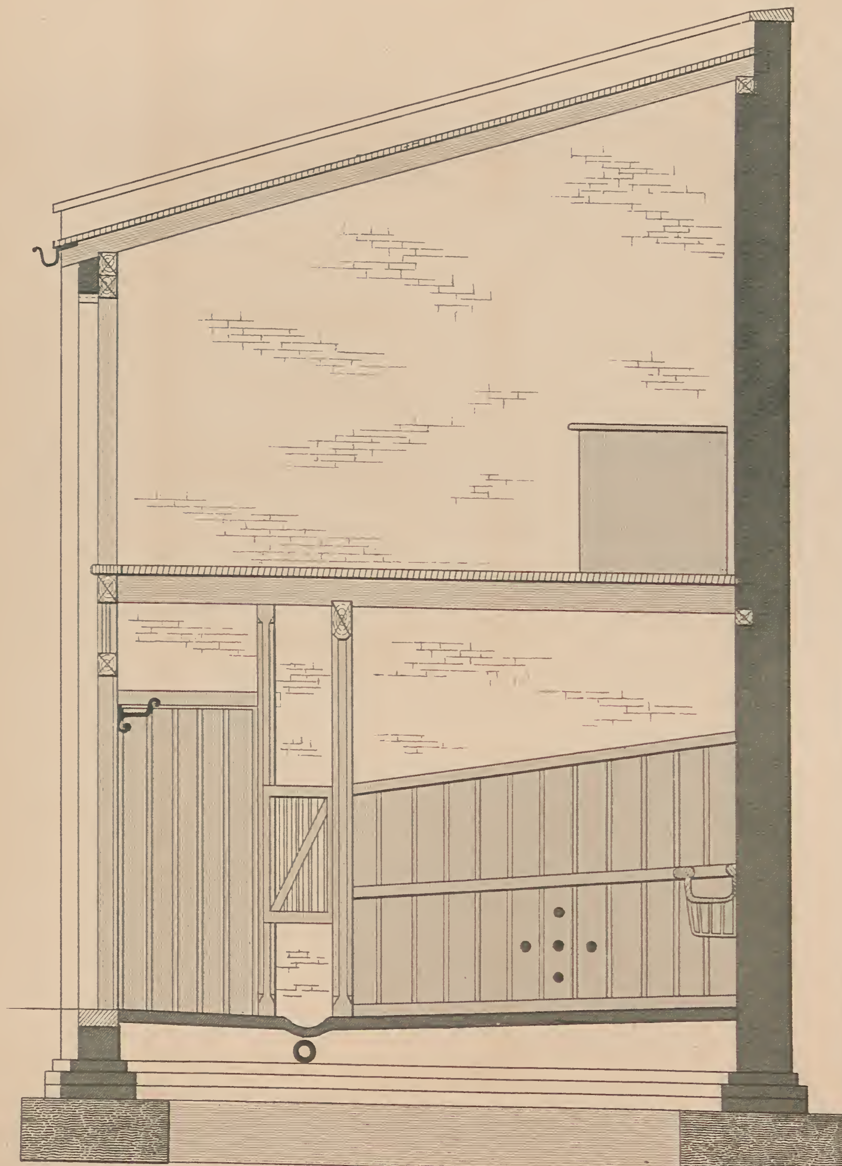
STABLE FITTINGS.

JOINER'S DETAILS, &c.

SECTION AT A.

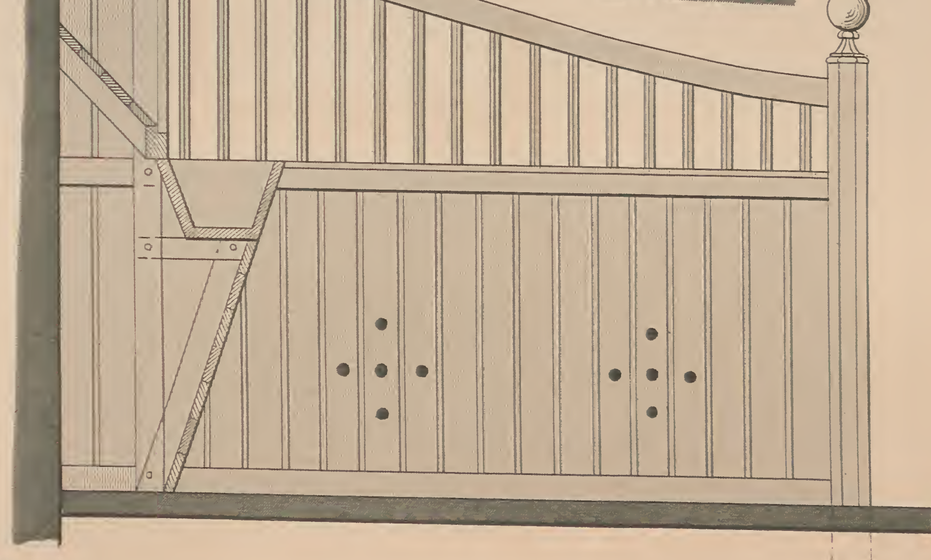
MANGER AND RACK.

(SCALE ½ INCH TO THE FOOT)



SECTION THROUGH STABLE (PLATE 48.)

SCALE OF 5 4 3 2 1 0 5 FEET



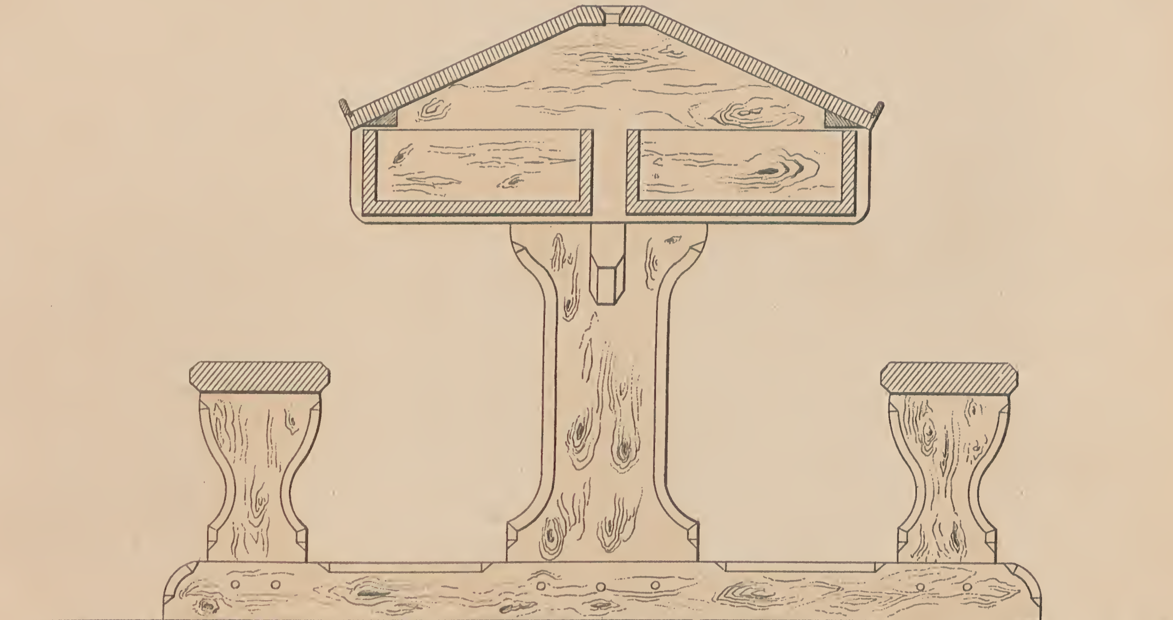
STALL DIVISION AND MANGER.

SCALE OF 0 1 2 3 4 FEET

J. K. Tarbuck, Architect

FITTINGS FOR SCHOOLS —

JOINER'S DETAILS.



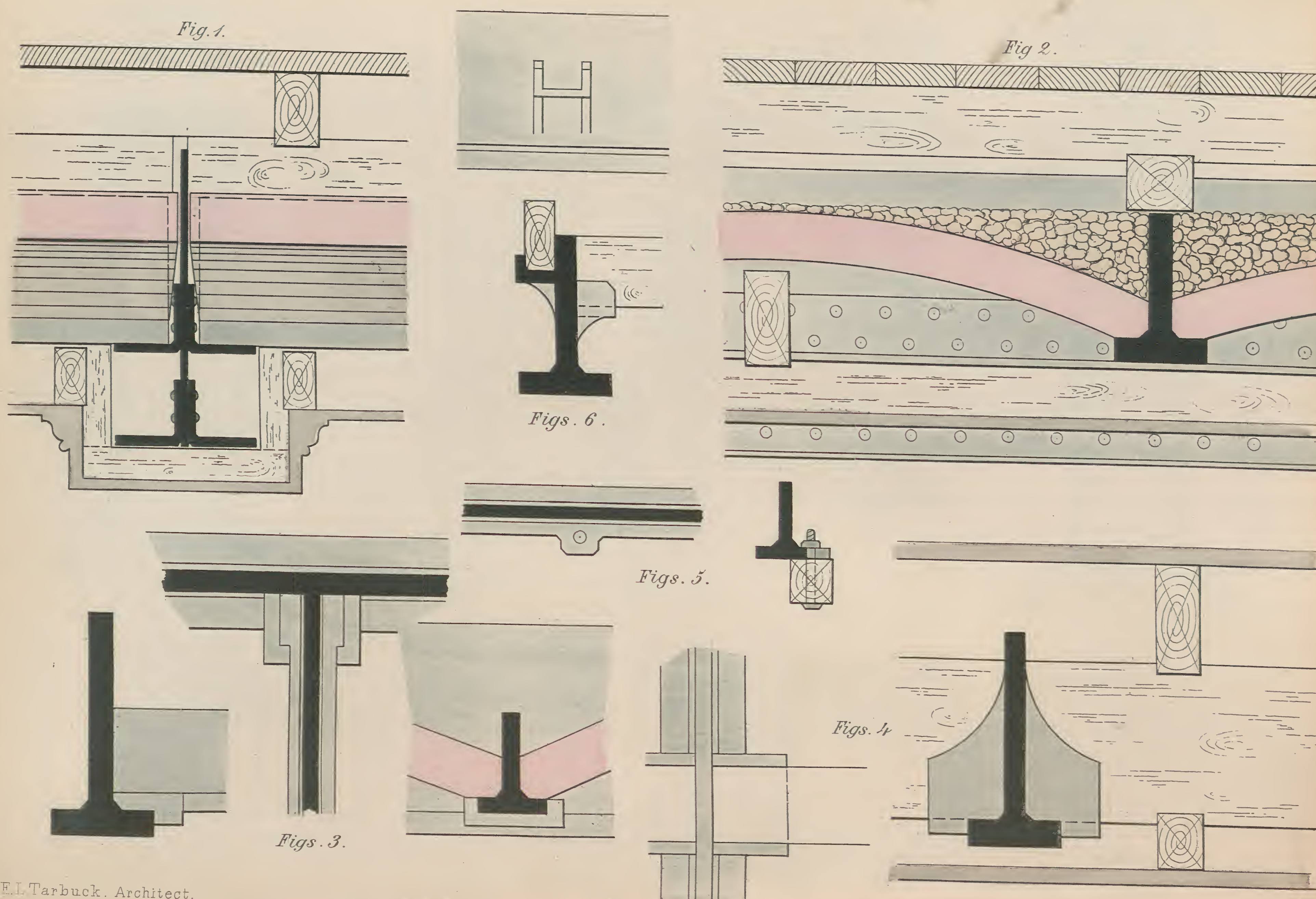
DESK AND SEATS.

DETACHED SEATS WITH BACKS.

SCALE OF 

FEET.

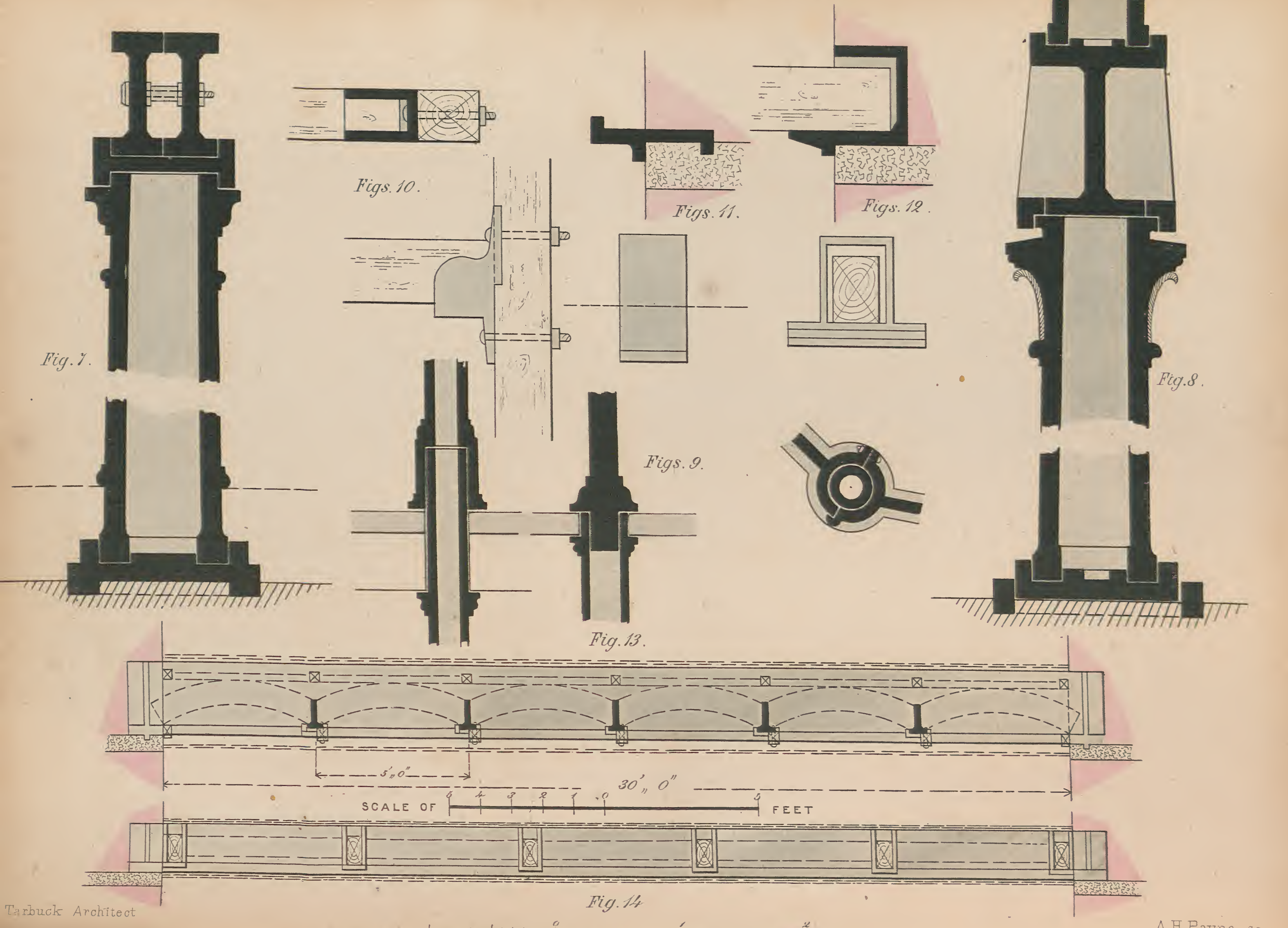
E.I. Tarbuck, Architect. A.H.Payne sc.



E. L. Tarbuck. Architect.

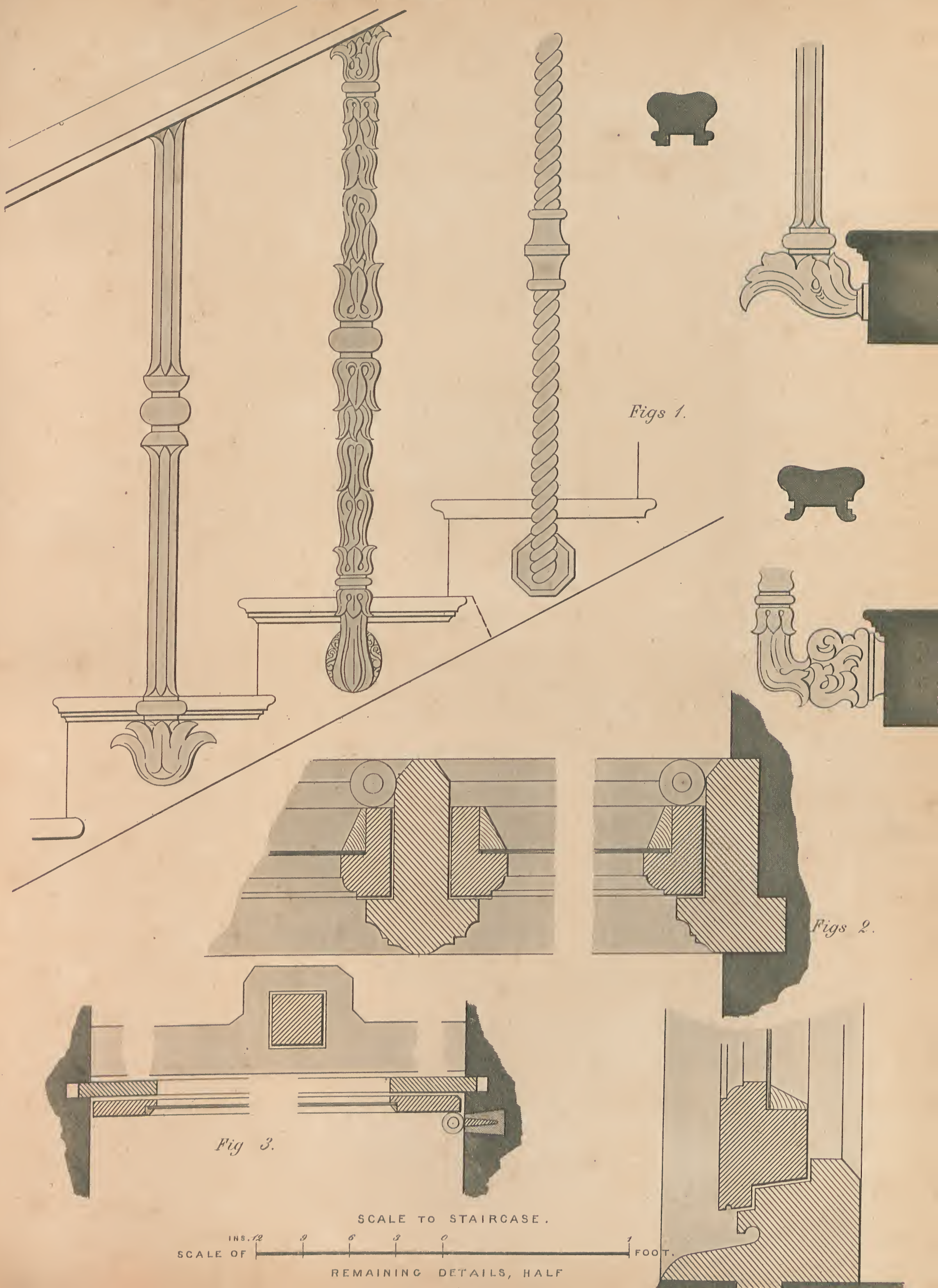
A. H. Payne

FIREPROOF CONSTRUCTION, ETC.

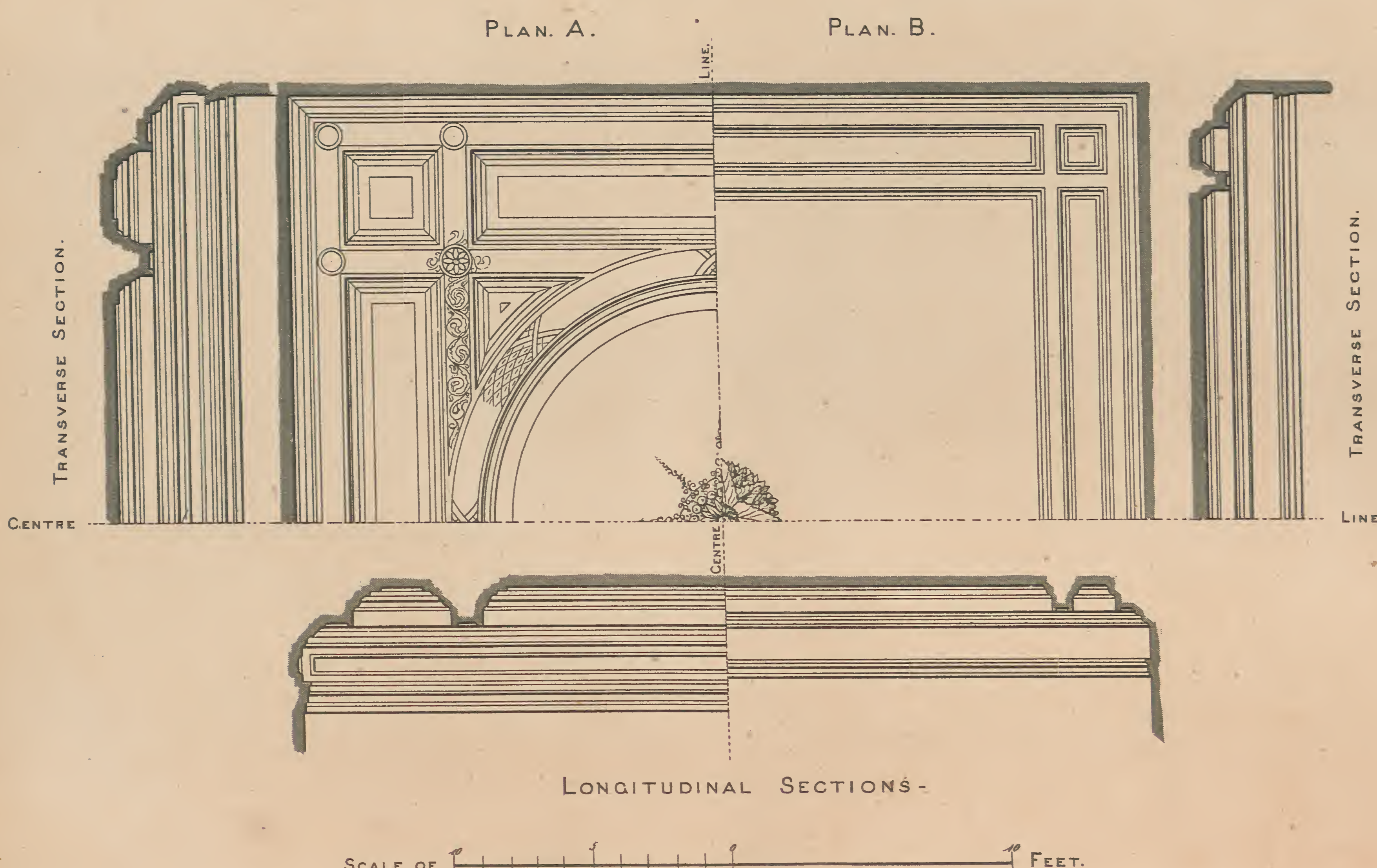


Tarbuck Architect

A.H.Payne sc.

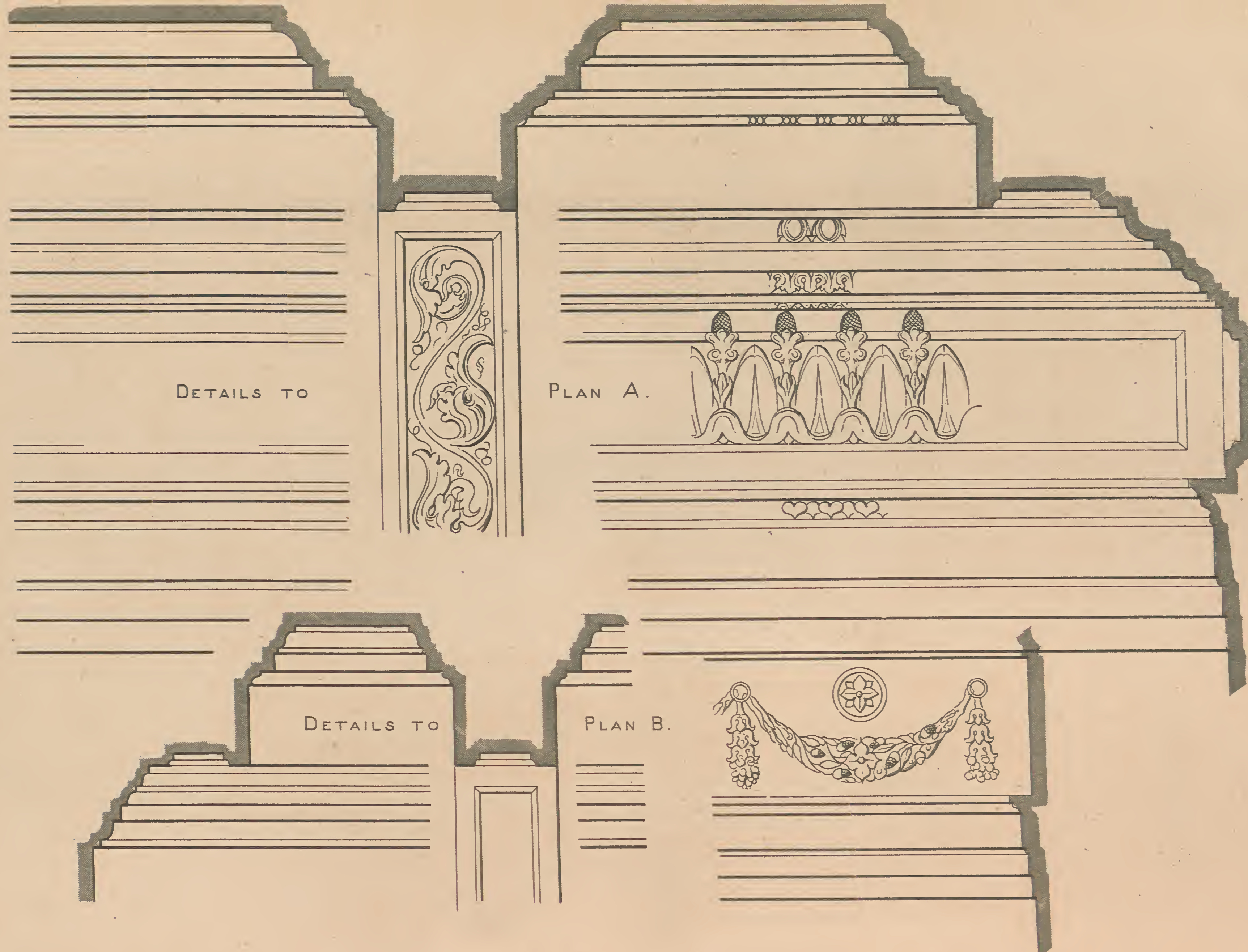

Figs 1.
Figs 2.
Fig 3.
SCALE TO STAIRCASE.
INS. 12 9 6 3 0 1
SCALE OF FOOT.
REMAINING DETAILS, HALF

Designs for two Ceilings.



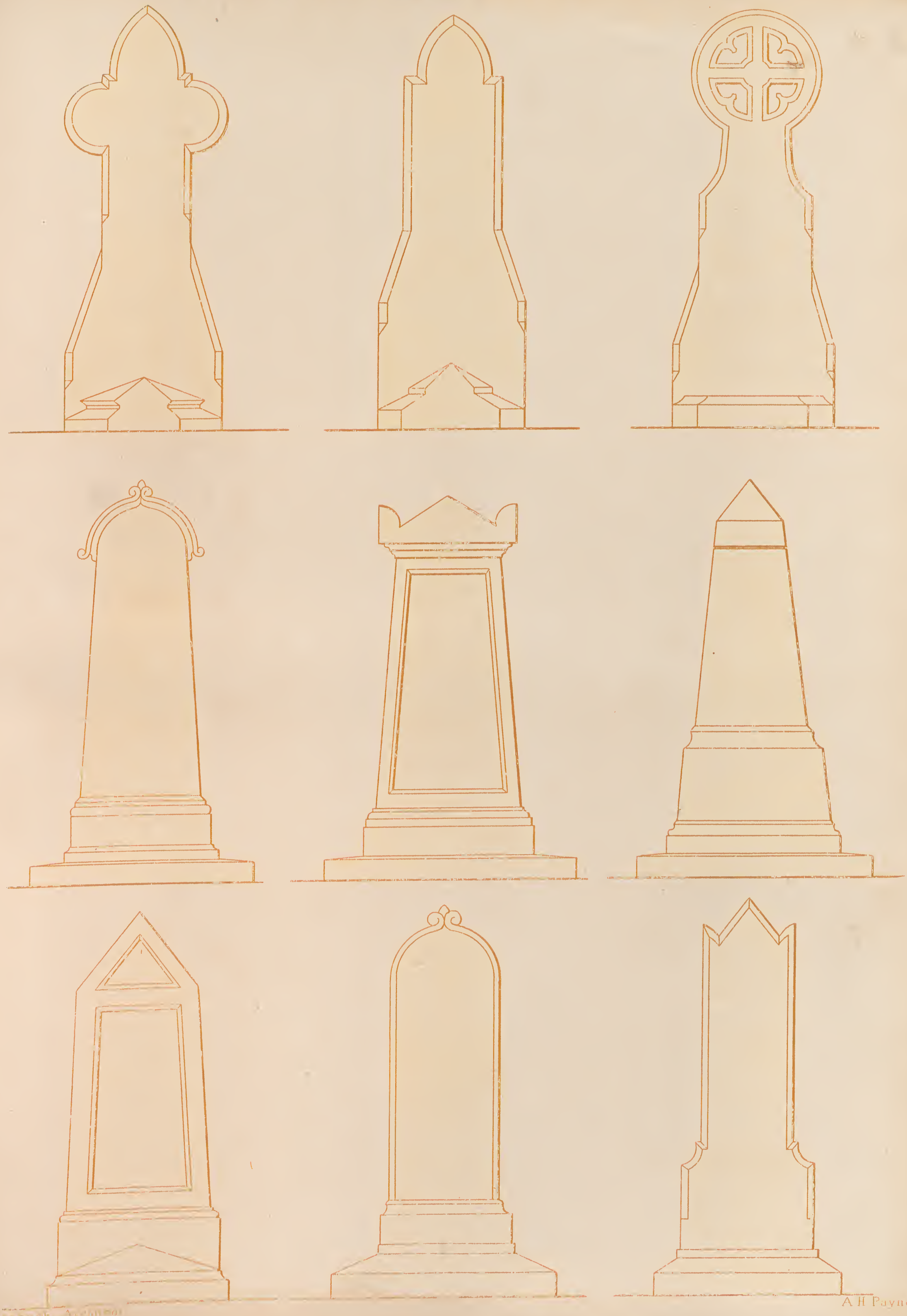
For details see plate 56.

E. L. Tarbuck. Architect. A. H. Payne sc.



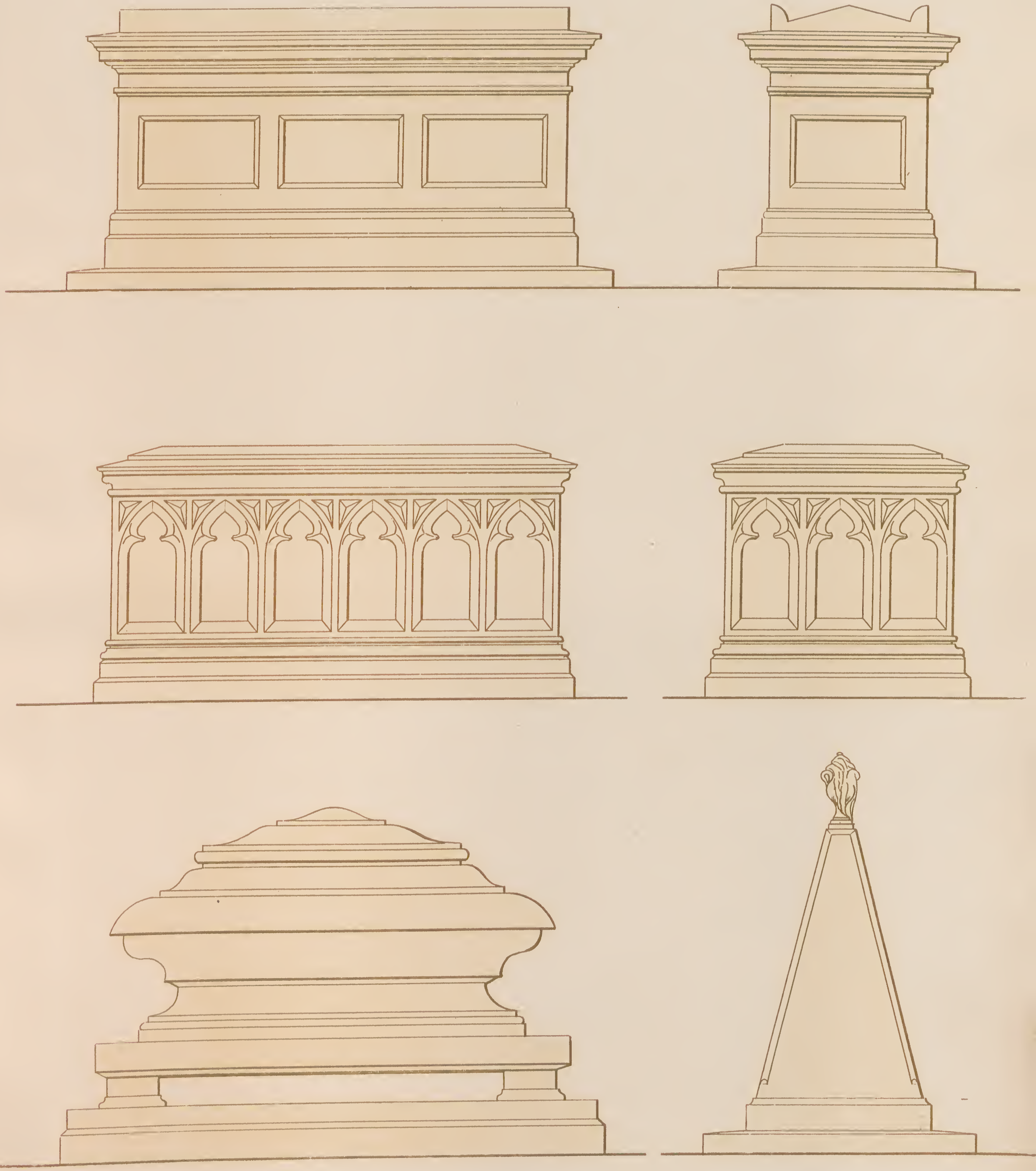
E. L. Tarbuck, Architect. Scale one Inch to the Foot. A. H. Payne

HEADSTONES, &c. FOR CEMETERY GROUNDS.



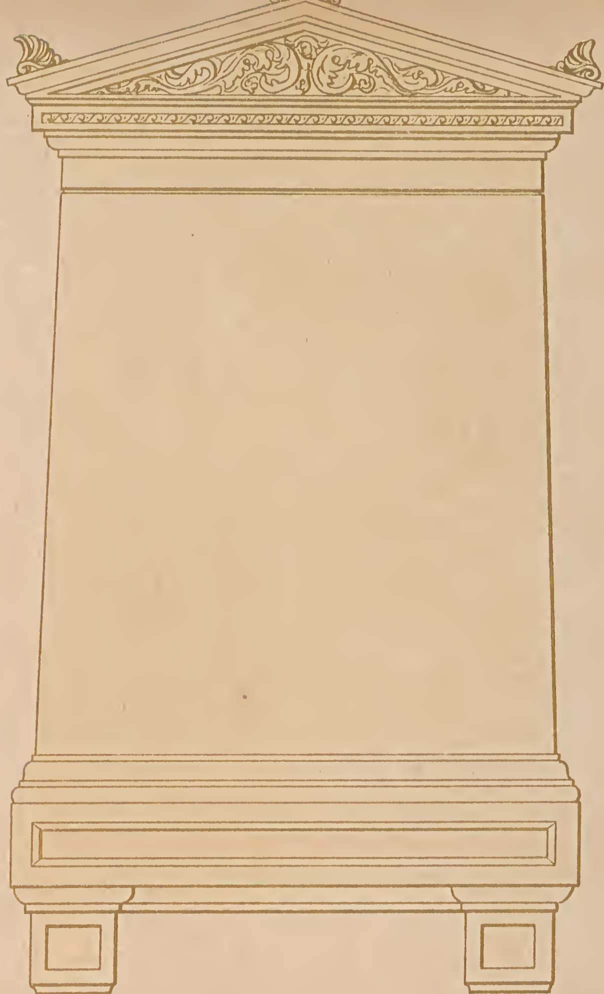
A H Payne

Monuments for Cemetery Grounds.



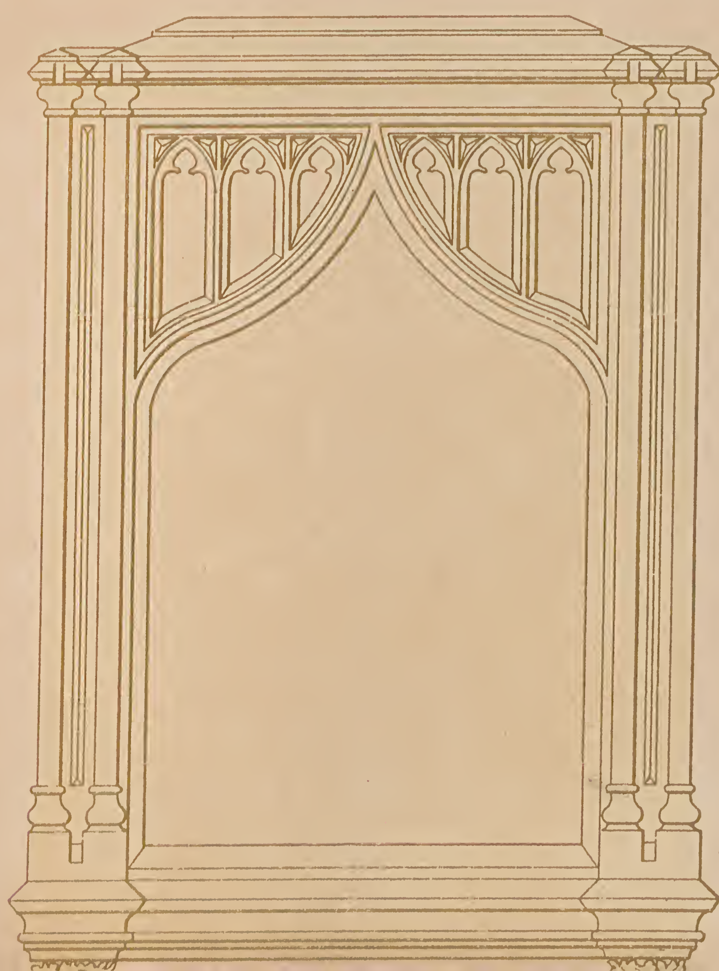
E. L. Tarbuck. Architect.

A H Payne sc



Mural Monuments

for Cemeteries.



E. L. Tarbuck. Architect. A. B. Payne sc.